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QUARTERLY REPORT, CONTRACTS AND GRANTS, OCTOBER-DECEMBER 1971

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QUARTERLY REPORT

CONTRACTS AND GRANTS

October - December, 1971

PPB 1704
PPB 1708

CONTRACTS AND GRANTS ACTIVITIES

QUARTERLY REPORT

October - December, 1971

C. A. Brunner

PPB Category 1704

17040 EUE - Rex Chainbelt, Inc. - "Feasibility Study of Using Reverse Osmosis to Concentrate Pre-Treated Domestic Sewage"

Objective: To establish through a laboratory study the feasibility of treating raw sewage with reverse osmosis and further treating the concentrated brine from the reverse osmosis by activated sludge.

Project Status: The reproducible copy of the final report has been received and will be published.

17040 FEE - Monsanto Research Corporation - "Hollow Fiber Technology for Advanced Waste Treatment"

Objective: To develop technology required to fabricate practical hollow fiber reverse osmosis modules for treatment of wastewater.

Project Status: Experimental work by the contractor was completed this quarter, and the draft of the final report was received and is being reviewed. A hollow fiber module was also received and will be tested at the Lebanon Pilot Plant beginning late in January.

PPB Category 1708

17080 EDE - Los Angeles County Sanitation District No. 2 - "Support of the Advanced Waste Treatment Pilot Plant at Pomona, California"

Objective: To continue technical and economic feasibility studies of a number of advanced waste treatment processes.

Project Status: The present contract ended October 31, 1971. A new contract has been negotiated, but not funded. The contractor is continuing operations.

17080 FSF - Contra Costa County, California - "Central Contra Costa County Water Renovation Project"

Objective: To determine the feasibility of a number of advanced treatment methods for producing water usable for industry.

Project Status: Experimental work was completed this quarter. A final report is being prepared.

17080 GCI - Los Angeles County Board of Supervisors - "Water Reclamation Project for Antelope Valley"

Objective: To observe the operation of a full scale water reclamation system producing recreational lake water and to develop a manual of practice for such operation.

Project Status: All three recreational lakes are now filled with renovated water and the renovation treatment system is operating satisfactorily. Evaluation of the lakes from the standpoint of acceptability for recreation is underway.

QUARTERLY REPORT

BIOLOGICAL TREATMENT RESEARCH PROGRAM

October - December 1971

PPB 328101
PPB 328105
PPB 328106

BIOLOGICAL TREATMENT RESEARCH PROGRAM

The objectives of this program are:

Adapt and/or develop biological waste treatment processes to accomplish efficient destruction of organic contaminants and concurrently remove inorganic nutrients such as nitrogen and phosphorus.

Adapt and/or have developed mechanisms and instruments for the automatic control of biological treatment processes.

Develop standardized procedures for measuring biodegradability of specific materials and mixtures under both aerobic and anaerobic conditions.

Develop guidelines for safe and efficient disinfection of effluents derived from AWT processes.

Subprogram elements assigned to this program are:

PPB 328101 - "Dissolved Nutrient Removal," Mr. E. Barth, Manager.

PPB 328105 - "Dissolved Biodegradable Organics Removal," Mr. R. Brenner, Manager.

PPB 328106 - "Microorganisms Removal," Mr. C. Chambers, Manager.

PPB 328101

DISSOLVED NUTRIENT REMOVAL

Work Done This Quarter

Final reports of projects generated under the 1701 subprogram element that have been received this quarter are as follows:

"Nitrate Removal from Wastewater by Ion Exchange" - 17010 FSJ 01/71.

"Phosphorus Removal and Disposal from Municipal Wastewater" - 17010 DYB 02/71.

"The Electro-oxidation of Ammonia in Sewage to Nitrogen" - 17010 EED 07/70.

"Development of a Chemical Denitrification Process" - 17010 EEX 10/70.

"Feasibility of Liquid Ion Exchange for Extracting Phosphate from Wastewater" - 17010 EAP 10/70.

"Advanced Wastewater Treatment as Practiced at South Lake Tahoe" - 17010 ELQ 08/71.

A draft of the final report "A Study of the Kinetics and Mechanism of Precipitation and Removal of Phosphates from Wastewater," 17010 EKI, has been received. The study compares the efficiency of ferrous iron vs ferric iron and aluminum as precipitants for phosphorus control.

A report of the first year's research under grant 17010 EPM has been received. The results show that efficient nitrification can be accomplished with pure oxygen. The biological reactor employs growths attached to 1-inch gravel. Upflow hydraulics are used. Oxygenation can be accomplished by direct bubbling of oxygen or by oxygen dissolution at one atmosphere ahead of the column and recycle of the column effluent. Oxygen concentrations in the range of 40 mg/l, and pH values over the range of 8.5 to 6.5 have not been found inhibitory to nitrification.

On September 14, 1971 discussions were held with representatives of the Arthur Respirometer Company and officials of Indianapolis, Indiana. We were approached in regard to funding a study to monitor the industrial wastes discharging into the Indianapolis sewer system, as a basis for surcharges. We expressed our thoughts on the inadvisability of using a biological system to monitor industrial wastes and the setting of sewer ordinances on the basis of BOD. Also, we discussed our severe budget limitations for FY-72.

Messrs. R. Wise and E. Barth and Dr. J. Farrell have further evaluated hyper-chlorination processes such as PEPCON and PURIFAX, after receipt of samples from PEPCON's Henderson, Nevada plant.

The PURIFAX and PEPCON processes differ in process aims, configuration, and chemistry. The PURIFAX process uses externally added chlorine with consequent depression of pH, to condition sludges for dewatering. The PEPCON process uses electrode-generated chlorine to treat digester supernatant in situ. Because of the electrode reaction no drastic pH change is noted.

Analytical investigations of samples from both processes have shown that neither process increases or decreases the amount of commonly encountered chlorinated insecticides or polychlorinated biphenyls (PCB's).

The Facility Construction and Operation Division of Region VI has asked our evaluation of these processes because they are being implemented into planned construction in that Region. Other than the finding of no net change in insecticides or PCB's we can not answer the environmentally important question of whether these hyper-chlorination processes produce extraneous chlorinated organic compounds or high concentrations of chloramines. Analysis of a sample of activated sludge from Fairlawn, New Jersey, after PURIFAX treatment, gave a vast amount of response to the electron capture detector which is suggestive, but not positive, indication of chlorinated materials. To ascertain the environmental hazards of these processes would require a specific work plan, and authorization to commit 4- to 5-man years of effort in a coordinated investigation by AWT, AQC, and the Athens, Georgia instrumentation group.

Phase I construction for phosphorus control at El Lago, Texas (11010 GNM) is well under way. New electrical circuits, concrete pads, dikes, tankage, and process piping have been set in place. Phase II, nitrification, and Phase III, column denitrification, are being combined into one bid package. The Cincinnati AWT staff is assisting the consultant on the process design for both large and fine media denitrification columns. Analytical monitoring has commenced.

Several months of data have now been collected at the Bissel Point Treatment Plant in St. Louis, Missouri (11060 GUT). The studies have concerned the use of high purity oxygen for treatment of this waste which is largely industrial, with a high soluble component. The oxygen process is highly efficient.

Work on contract 17010 SFJ with Dow Chemical Company has progressed to the point where the hydraulic application rate of 1 gpm/sq ft is well established as regards the ability to nitrify secondary effluent on plastic media. It appears that superimposed on this limit may be a nitrogen loading limit expressed as pounds of ammonia nitrogen per 1,000 cu ft per day. Preliminary results show a much reduced chlorine demand of the nitrified effluent as compared to the same effluent before nitrification.

Personnel of the Renton Treatment Plant of Metro Seattle, Washington participated in the recent Technology Transfer Program at Seattle, Washington. They presented the details of the automatic metallic salt dosing system and process evaluation for phosphorus control, developed under grant 17010 EDA.

Difficulty is still being experienced at Grand Rapids, Michigan (11010 ENK) with process control to consistently obtain an effluent of 1 mg/l or less of phosphorus.

In order to correct this the usual method of operation of adding ferric chloride and polymer to the raw waste has been altered. The ferric iron is still added to the raw waste but polymer dosing has been stopped to see if the secondary sludge will scavenge the insolubilized iron; this should also relieve part of the sludge load to the primaries. Additionally, a liquid tank truck is being fitted so a polish dose of iron can be added at the mixed liquor entrance to the final settling tanks. This is to improve solids control in the final effluent since the solids contribute to the inability to maintain less than 1 mg/l of phosphorus in the effluent.

Riverview, Michigan has returned the $494,194 demonstration grant (17010 DSN) offer. The secondary facilities at Riverview were never constructed, so no demonstration funds could be utilized. A memorandum was sent to Dr. Greenfield requesting that he reapportion this fund to the 1701 subprogram element.

Second stage nitrification is under evaluation in pilot scale operation at the University of Colorado (17080 DOI). Loss of solids in the second settler is an operational problem even at the low overflow rate of 400 gpd/sq ft. Chemical additions are planned for solids control, in conjunction with control of recycle pumping.

The new 5 mgd facility at Hatfield Township, Pennsylvania (11060 FRQ) is 99 percent complete. On January 1, 1972, each unit process will be wet tested before placing the entire system into operation. This project is a jointly funded study, employing Facilities Construction and Operation, township, and OR&M funds for this advanced facility. The process will be a combination of chemical-physical and biological

technology. Preliminary analytical analysis has begun. High concentrations of both nitrogen and phosphorus were found in the receiving stream, attesting to the need for AWT in this geographical area. This type of background stream monitoring will be helpful in showing the impact of AWT on receiving waters.

The field-scale work at Kansas State University (17050DCC) employing low lime coagulation followed by biological oxidation of organic carbon, has been completed and the final report is in preparation.

The rotating disc and flow channel studies at Marquette University (17010 DXG) are nearing completion of the experimental phase. The cellular uptake of phosphorus was difficult to predict even under conditions of controlled nutrient and mineral salt composition of the synthetic substrate.

On October 21, 1971 two reporters from Fortune Magazine visited the Biological Treatment Research Program and toured the pilot plant facilities and discussed techniques for phosphorus removal. They were interested in plants that are currently removing phosphorus and the general future direction of wastewater treatment. A feature story will appear shortly in the magazine and pictures of the Richardson, Texas plant will be used to heighten reader interest.

A contingent of representatives from each of the AWT Programs visited Headquarters on November 29-30, 1971 to discuss the cost of phosphorus removal. The Headquarters staff have been estimating phosphorus removal costs on the basis of chemical requirements and dosing equipment only. The AWT contingent's position was that, in addition, provision must be made for additional sludge handling capacity. During the discussions ground rules and assumptions were resolved which can be used to estimate a range of capital costs that treatment plants will experience when phosphorus removal is implemented. These data can be used by the Administrator to support his public statement that EPA will assist plants in the Great Lakes area that must start treatment for phosphorus control.

During the first week in November, Mr. G. Gruber installed and operated the mobile digester supernatant treatment trailer at Albuquerque, New Mexico. Results of five runs show excellent

efficiency of the lime treatment and ammonia stripping processes for suspended solids, COD, phosphorus, and nitrogen removal. Mr. Gruber trained the local staff in details of process operation and they are continuing with the study.

Budget restrictions have altered plans for construction of an external building to house chlorination facilities and the compressor for diffused air in the Experimental Wing area. A single protective covering will be designed for the chlorine cylinders. The present noise level of the compressor is unacceptable and solution of this problem is necessary.

A summary work plan for subprogram element 328101 for FY-72 showing man power and money resources to confirm to the October 15, 1971 allocation has been prepared.

Work Planned for Next Quarter

Continue anaerobic studies of NTA.

Start construction of protective covering for chlorine cylinders.

Evaluate ways to alleviate compressor noise.

E. F. Barth

PPB 328105

DISSOLVED BIODEGRADABLE ORGANICS REMOVAL

Work Done This Quarter

Work Plan 17050 TLI - "Upgrading Trickling Filter Effluent Quality"

1. Grant 11010 EGL - City of Richardson, Texas - Work this quarter has focused on optimization of the liquid alum dose to the final clarifier. The Al/P mole dose has been decreased from the 1.8-2.0 value used in previous quarters to 1.4-1.5. The only noticeable effects of decreasing the coagulant dose has been a slight increase in effluent phosphorus from an average 0.5 mg/l to 0.7 mg/l and in effluent suspended solids from 7-10 mg/l to 12-13 mg/l. Effluent BOD remains well below 10 mg/l and effluent COD is still averaging 40-50 mg/l. Dual media filtration of a small slip-stream of clarified trickling filter effluent continues to consistently further decrease suspended solids to 0-2 mg/l and phosphorus to 0.1-0.2 mg/l. A grant extension application for $27,853 to continue the studies through the winter months has been processed through Headquarters and is now being held in GAD. If the grant extension is not formally awarded by December 23, 1971, experimental work will have to be discontinued.

2. Contract 14-12-505 (11010 DGA) - University of North Carolina - Work is now in progress to install alum addition equipment. During the last five months of the contract (January through May, 1972), attempts will be made to duplicate the excellent results obtained at Richardson, Texas via alum addition to the final clarifier of a trickling filter. The upgrading job on the Carolina filter is expected to be somewhat more difficult as it is a high-rate filter. Richardson's filters are standard-rate units. The Carolina plant has two identical trains permitting data from a control as well as a dosed train to be collected. If the initial results from the alum addition program are highly successful, the University will probably apply for a 3- to 4-month extension grant so that chemical requirements and incremental sludge production can be properly evaluated.

3. Grant 11010 HIR - City of Ely, Minnesota - Construction of the teritary treatment plant is now in full swing. The 1.5 mgd tertiary facility (all indoors) will include flow equalization, two-stage lime precipitation, dual-media filtration, and thickening and vacuum filter dewatering of lime sludge. Feed to the tertiary plant will come from the City's high-rate trickling filter plant. The objective of the project is to upgrade the trickling filter effluent and remove phosphorus to levels of 0.05-0.01 mg/l in an attempt to demonstrate restoration of the highly eutrophied receiving water (Shagawa Lake). Completion of construction is scheduled for mid-1972. EPA will then operate both the secondary and tertiary plants for the City for three years with an option of an additional three years if deemed necessary to demonstrate the objectives. Meanwhile, collection of background data on the present condition of the lake continues.

Work Plan 17050 TGP - "Handling of Activated Sludge from Oxygen Aerated Plants"

1. The in-house winter test program to determine the effect of wastewater temperature on the settling rate of oxygen aerated activated sludge is well underway. Two days of settling tests have been conducted so far on "UNOX" pilot plant mixed liquor at Baltimore and St. Louis, one day each during the autumn when temperatures were high and one day each during December after water temperatures had dropped 10-15°F. A warm temperature test has also been completed at Passaic County, New Jersey with the cold temperature test coming up in January. Two days of testing are also scheduled at Philadelphia, one day in January and the other next spring. In addition, routine sludge settling tests are conducted at Blue Plains. At the termination of the data collection phase next spring, all of the data will be reviewed and correlated in a report. The objective of the program is to derive design criteria for secondary clarifiers for oxygenation systems which consider the major parameters (including temperature) affecting sludge settling velocity. The report should be of value to the Technology Transfer and Construction Grants programs as well as to R&D.

Work Plan 17050 TGK - "Development of Competitive Oxygen Aeration Systems"

1. Grant 11010 GEV - New York City, N. Y. - Construction work on the conversion of an existing 20-mgd aeration bay at the City's Newtown Creek Plant continues to be hampered by labor stoppages. The latest labor dispute has pushed the estimated start-up date back to March, 1972. Demonstration and evaluation under varied operating conditions will then follow for one year. The long range objective is to demonstrate the applicability of upgrading existing overloaded secondary facilities via conversion to oxygenation without increasing aeration tankage requirements. This project, if successful, holds potential impact for many existing facilities throughout the country. There are 320 mgd of treatment capacity at Newtown Creek alone that need upgrading to provide good treatment. The numerous design and construction delays that have been incurred in trying to work through the New York City bureaucracy and permit system have resulted in increased engineering and construction costs totalling about $125,000. The City intends to apply for additional funds in FY-73 to cover these overrun costs.

2. Grant 17050 HKX - City of Las Virgenes, California - Installation of the covered single stage Cordon International Oxygenation System at Las Virgenes is fairly well on schedule. Start-up is planned for early February, 1972. A decision has been made to use an inflatable type fabric cover for the oxygenation tank, similar to hospital oxygen tents. For purposes of inspection, there will be enough head room

for access. In a permanent installation, the cover is envisioned as being installed at tank freeboard elevation. This type of cover was selected because of cost considerations and since it does not support any heavy equipment as the Linde system does. The objective of this project is to demonstrate an oxygenation system that approaches "UNOX" in organic loading capability with considerably less capital investment.

3. In-house Blue Plains Oxygen Aeration Study - The oxygenation pilot studies at Blue Plains are continuing with emphasis on achieving the proper match between reactor and clarifier geometry. A fourth biological stage has been cut in reducing the MLSS level from 6000 to 4500 mg/l while maintaining a sludge age of 7-8 days. The clarifier has been modified by cutting the center feed well depth from 7' to 3'. The effect of these changes has been to produce a denser more rapidly settling sludge with some sacrifice in effluent quality. With the shallow clarifier feed depth, the clarifier tends to act as a classifier with the finer inert particles no longer being trapped and enmeshed by the settling blanket but leaving the clarifier in the effluent. The settling mixed liquor thus freed of some of the finer inerts assumes an apparent higher density and settles more rapidly at conventional overflow rates. The escaping fine inerts have thus far, however, approximately doubled effluent BOD and suspended solids from 10 and 15 mg/l, respectively, to 20 and 25-30 mg/l. Plans during January are to evaluate the new clarifier mode of operation at an MLSS loading of 6000 mg/l. In February, the unit will be switched from primary effluent to raw wastewater feed.

Work Plan 17050 TCU - "Treatability of Specific Industrial Wastes"

1. In-house RATWRC bench scale project for determining efficiency of biological processes in removing various types of organic compounds normally contained in municipal wastewaters.

   Studies were initiated to evaluate a new blow-off method for the determination of nonionic surfactants in influents and effluents of biological pilot plants and to compare its sensitivity with that of the cobalt thiocyanate method for nonionic detergents. The blow-off method is based on the use of a modified Dragendorff reagent.

   The three nonionic surfactants used in the studies were: 1) fatty alcohol ethoxylate with 30.7 ethylene oxide units, 2) fatty alcohol ethoxylate with 10.6 ethylene oxide units and, 3) nonylphenol ethoxylate with 9.0 ethylene oxide units. The results with the cobalt thiocyanate method indicate good sensitivity in the range of 100-1,000 μg of each of the three nonionic surfactants. The degree of sensitivity increases

with the increase in the number of the ethylene oxide units on the surfactant. Standard curves were produced for each of the three surfactants, by either by-passing the extraction procedure or using the chloroform or ether extracts of the detergent from aqueous media. The sensitivity slightly decreased with extracted surfactants and the percent recovery for each of the compounds was determined to be in the range of 90 to 95 percent.

Preliminary experiments on potentiometric titrations of the modified Dragendorff reagent with pyrrolidine dithiocarbamate provided analytical data which indicate the sensitivity of the method. Standard curves show high slope and are very reproducible. The analytical data on the three nonionic surfactants are limited so far to studies in which the blow-off extraction procedure was by-passed. Potentiometric titration results provide evidence of very high sensitivity in the range of 20-1,000 μg of each of the three nonionic detergents. Sensitivity is reproducible and high enough to produce changes in potentiometric peaks with 10 μg increment changes in concentration of each of the compounds.

Studies are in progress to determine the levels of natural urinary steroids and synthetic ovulation inhibiting steroids in treated and untreated wastes from treatment plants within a 50-mile radius of Cincinnati. Preliminary chromatographic data on the influents reveal the presence of the natural urinary estrogenic hormones, estriol, estrone, and estradiol. Chromatographic studies are in progress to identify and quantitate the estrogenic and progestational ovulation inhibiting hormones in the extracts of the concentrated sewage samples. Studies are under way to analyze the sewage treatment plant effluents for the presence of the natural urinary steroids and the ovulation inhibiting hormones.

2. Grant 17050 DUT - Texas A&M Research Foundation - "The Molecular Nature of Organic Waste Removal Patterns" - Work has been completed and publications from the work have been presented at several meetings. The preparation of the final report is in progress.

Work Plan 17050 TGS - Exploit the Use of Biological Rotating Discs"

1. One of our biggest technical problems is the treatment of small and highly variable flows. Activated sludge and trickling filter systems do not react well in these situations. Claims have been made for the rotating biological disc (RBD) method that it is capable of handling this type of flow condition, that it requires little operator attention, and is relatively maintenance-free. If these claims can be substantiated, the RBD system would be applicable to literally thousands of small flow situations in camps, parks, rest-stops, trailer parks,

and other tourist attractions. A grant application for $16,194 has been developed by the University of West Virginia to evaluate an RBD installation at a YMCA camp during the summer, 1972. This application is being processed and will receive a strong recommendation for funding.

Work Plan 17050 TGL - "Removal of Liquid Only from Biological Reactor"

1. Secondary clarifiers represent the single most limiting factor in treatment efficiency of and organic loading to activated sludge systems. Activated sludge systems are designed and operated not to take maximum advantage of biological kinetics but to produce a readily settleable biomass. This modus operandi, of necessity, severely curtails the flexibility and increases the cost of the process. A method of liquid/solids separation that does not rely on gravity clarification and to a large extent is independent of sludge settling characteristics would represent a significant technological breakthrough. Toward this end, the FMC Corporation has submitted a research contract proposal to evaluate the feasibility of utilizing ultrasonically cleaned rotating strainer drums to clarify mixed liquor. This will be a two-stage process with the primary strainer being immersed directly in the aeration tank. Strained mixed liquor solids are retained in the aerator. The effluent from the primary strainer is then directed to a secondary polish strainer that is located in a small holding tank external to the aerator. It is hoped that the effluent from the secondary strainer will contain 20 mg/l or less of suspended solids. The cost of the project is $67,500. The contract package is now being prepared for consideration and awarding by NERC. This initial feasibility type project is a high program element priority area.

Work Plan 17050 THH - "Expanded Bed Biological Treatment"

1. In-house research project to evaluate the feasibility of combining advantages of increased oxygenation capacity of a pure oxygen aerating medium with the increased active solids that can be maintained as surface slimes in an upflow fluidized bed reactor employing granular media (Lebanon) - Experiments this quarter have centered on selecting column media which resist abrasive breakdown and loss and on optimizing system hydraulics to retain all of the media within the column. These hydraulic problems have been essentially solved by using an expanded section at the top of the column. Rise rates are maintained at 16-20 gpm/ft^2. At these rise rates, empty bed contact time on primary influent varies from 10-15 minutes. Data collected to date indicate a soluble COD reduction with this detention time of 30-45%. As soon as the freeze is over, column capacity will be increased by 200% to provide empty bed contact times of 30-45 minutes. If the process is to show significant potential, it must be able to achieve efficient organic removal at these latter detention times.

Work Plan 17050 TGT - "Method for Measuring Active Mass of Activated Sludge"

1. Grant 17050 GAI - Georgia Institute of Technology - "Measurement of Active Biomass Concentrations in Biological Waste Treatment Processes" - This project is attempting to use the dehydrogenase content of microbial cells to correlate to and determine active mass. The first year's work has progressed very well. The first year interim report has been received and a request for the second year continuation of $24,500 was submitted early last summer. The request was approved and has been processed through Headquarters up to the Grants Administration Division. In the meantime, the school has been carrying the staff on its own funds since September, 1971. The principal investigator has been directed by the school administration to release the staff at the end of December if a grant award has not been received by that time.

2. Grant 17050 GUJ - Rutgers University - "Actinomycetes of Sewage Treatment Plants" - The increasing appearance of actinomycetes scum has reached such proportions as to be a serious operating problem in activated sludge plants. The floating scum plagues plants in all parts of the country and is not isolated to one climate. Dr. Lechevalier at Rutgers is probably the foremost expert in the country to do basic research in this problem area. An interim progress report has been received and approved. Over 120 strains of actinomycetes from different activated sludge plants have been isolated so far in the first year's work. An application for a second year continuation has been received for $27,271. The grant funds for the first year will be depleted in February, 1972. At this time, there appears no way possible to fund the continuation in FY-72. Consideration will be requested in the FY-73 budget.

3. Grant 17050 DBL - Pennsylvania State University - "Bacterial Zoogloea Formation" - This project to collect and evaluate data related to the factors and mechanisms that affect and enhance good floc formation is in the midst of a one-year, no-additional-cost extension (9/1/71-8/31/72) to obtain additional information.

4. In-house (RATWRC) project to determine the accuracy of the Biospherics Incorporated adenosine triphosphate (ATP) meter on standard solutions and wastewater and sludge samples - Early work with the ATP luminescent meter showed rather large variations in individual replicate analyses even with pure ATP standards. Study of the reports by Biospherics suggested that this may have been caused by splashing of injected ATP sample and incomplete mixing of the ATP with the luciferin-luciferase assay material. Attempts

to improve reliability by adding the ATP first and then injecting the assay material through the septum were only slightly better. Good replication was achieved, however, by avoiding injection through the septum. Accuracy on standard ATP samples has been improved to ±0.1-0.5% by this technique.

The amount of ATP present in the free ATP pool in the cells of activated sludge can be measured after extracting the ATP from the cells. Accuracy of the procedure is within ±0.5-5.0%. Experiments are now under way to determine whether more concentrated activated sludge can be used for the extraction. This would give a lower dilution factor and minimize the magnification of any variation or error. Further testing will be necessary to determine the optimum amount of sludge to be extracted.

Final Reports

1. Preparation of the first draft of the final report for Grant 17050 GIU, "Laboratory Evaluation of a Method for Enhancing the Kinetics of Activated Sludge Treatment Plants," Houston Research, Inc., will begin within the next sixty days.

2. The draft report for Grant 17050 DGJ, "Electrical Stimulation of Waste Treatment," University of Michigan has been submitted. Extensive revisions are necessary. Approval target date is June, 1972.

3. The draft report for Grant 17050 DHI, "Isolation of Lytic Agents Related to Sphaerotilus," Randolph Macon Women's College has been submitted. Approval target date is the end of January, 1972.

4. The draft report for Grant 17050 DFJ, "Concentration of Chemicals by Floc-Forming Organisms," Ohio State University has been submitted. Approval target date is April, 1972.

5. The draft report for Grant 17050 DFL, "Adaptation of Microbial Populations," University of Cornell has been submitted. Approval target date is the end of January, 1972.

6. The draft report for Grant 17050 EAN, "Treatment of Wastes Using Peat and Peat in Combination with Soil," State of Minnesota has been submitted. Approval target date is February, 1972.

Work Planned for Next Quarter

Continue monitoring active contracts and grants.

Continue working to get the approved FY-72 contract and grant program funded and implemented.

Begin working on FY-73 work plans, budget needs, and priority lists.

Continue in-house and pilot plant activities as planned on:

1. Co-operative RATWRC/Blue Plains oxygen-aeration sludge settling tests.

2. Development of expanded bed biological treatment system at Lebanon.

3. Evaluation of modified method of operation of Blue Plains oxygenation system.

In-house (RATWRC) Waste Treatability Project:

Continue studies to:

1. Evaluate the new blow-off, modified Dragendorff reagent method for nonionic surfactants and compare it with the cobalt thiocyanate method for nonionic detergents.

2. Determine the types of phytosterols present in sugar beet tissues and to assay for the presence of the fecal sterol, coporstan-3B-ol, on the surfaces of the plants.

3. Establish the efficiency of waste treatment processes to remove synthetic estrogenic and progestational components of oral contraceptives from sewage.

In-house (RATWRC) Active Mass Measurement Project:

Standardize the test for the ATP level in activated sludges and determine the variations in ATP level of sludges throughout the different periods of a day and also at different feeding rates and levels of activated sludge mixed liquor volatile suspended solids.

PPB 328106

MICROORGANISMS REMOVAL

Work Done This Quarter

"Destruction of Microorganisms in Wastewater" - 17060 TBY

Sufficient experimental evidence has been accumulated to prove conclusively that radiation of Escherichia coli with high frequency gamma rays from a Co^{60} source followed by exposure of the organisms to monochloramine does not result in any measurable synergistic effect. The concentration of monochloramine was varied between 0.30 mg/l to 0.46 mg/l. The test water was glass distilled and buffered to pH 7.8 with 0.025 M phosphate buffer.

In each experiment the temperature remained constant, so that the bacteria in each test flask were subjected to identical conditions during exposure to chloramine and subsequent exposure to gamma radiation. The temperature from experiment to experiment varied, however, ranging from 22°C in the colder months to 26°C in the warmer months, due to the fact that the room was poorly insulated. Nevertheless, these small temperature differences had a negligible effect on the overall results. Every test showed a slight loss of chloramine (about 15%) due to the high concentration of organisms used in the experimental flasks. This was confirmed by three separate experiments in which no appreciable demand was observed by organisms up to a concentration of 10^6 per ml but at 10^7 per ml the slight demand was noted.

These results strengthen the earlier data, reported in the second quarterly report of 1971, which established that exposure of log phase cells simultaneously to gamma radiation and chloramine resulted in additive to less than additive bactericidal effects. In that phase of work the less than additive effect was explained by the somewhat rapid radiolysis of the chloramine concomitant with the disinfection of the organisms. In this phase of work, however, the organisms were exposed sequentially, rather than simultaneously, to radiation and chloramine, so that no radiolysis of the chloramine was possible. Thus, the full effect of the chloramine was felt by the organisms, and still no synergism was observed.

"New Microbial Indicators of Wastewater Chlorination Efficiency" - 17060 EYZ, University of Illinois, Urbana, Illinois.

Work in this quarter has been devoted primarily to improving means of enumerating the previously reported potential indicator organisms and to a further study of their origin in wastewater. A literature study is being carried out simultaneously with laboratory studies designed to characterize the metabolism of these potential indicator organisms.

This information is important because development of improved selective culturing techniques for more easily and accurately enumerating these organisms in wastewater can be expedited by a better understanding of their metabolic pathways. Thus far, most of the yeasts found in wastewater are similar to those found in feces and to culture No. 30 (one of the potential indicator organisms).

An application for a new grant to continue this work has been received. A three-month, no cost extension for continuation of this work through February 28, 1972 has been granted.

"Parallel Ozonation and Chlorination with Dechlorination of Chlorinated Effluents" - 17060 HJB, City of Wyoming, Michigan.

Good progress continues in this grant. Because of problems encountered in construction work the project is somewhat behind the original schedule. The engineer engaged by the City of Wyoming to manage the project has done an outstanding job of breaking difficult "bottlenecks" to keep the project moving. The contract for construction of the building to house the bioassay studies at Grandville has been awarded and construction is underway and the wells are under contract and being drilled. Exterior plumbing at Wyoming is 60 percent completed and building alterations to provide bioassay space at Wyoming are complete.

Personnel from Grand Valley State College (under contract for the bioassay studies) have occupied the space provided at Wyoming and are assembling and constructing equipment for use at both Wyoming and Grandville. This will markedly expedite equipping the Grandville bioassay laboratory once construction of the building is complete. Small pilot scale dechlorination studies with sulfur dioxide have been successfully completed. Results of these studies will provide a good basis for formulating a preliminary operating rationale when modified plant scale application of dechlorination with sulfur dioxide is initiated.

"The Detection and Inactivation of Enteric Viruses in Wastewater" - 17060 EAM, Hebrew University, Jerusalem, Israel.

This grant has come up for renewal and presumably has been funded.

"A Comparative Study of the Inactivation of Viruses in Wastewater by Chlorine and Chlorine Compounds" - Contract 14-12-567 (17060 DUO) - University of Cincinnati, Cincinnati, Ohio.

A no fund extension has been granted through December 31, 1971. A final report is anticipated in the near future. An application for a grant to continue this work has been received.

Projects 17060 EAM and 17060 DUO are being monitored by Dr. Gerald Berg.

Work Planned for Next Quarter

Compile data on the 3rd and final phase of the pure water study in which the organisms will be exposed first to monochloramine and then to gamma radiation. After this phase is satisfactorily completed, some experiments on secondary effluents will be attempted in order to find out if the same additive, non-synergistic phenomenon is observed in wastewater. Publication of results of the entire project will be started.

Plans are in progress for initiating studies to evaluate the disinfecting efficiency of the chlorination system being installed at the AWTRL pilot plant at the Robert A. Taft Water Research Center. In addition, plans are being made to initiate studies to determine the efficiency of various processes incorporated in the Blue Plains pilot plant to remove both indicator and pathogenic microorganisms.

C. W. Chambers
A. D. Venosa

PPB 310401

PHYSICAL-CHEMICAL IDENTIFICATION OF POLLUTANTS

Work Done This Quarter

"Identification of Organic Components of Sewage and Treated Effluents" - 16020 TIB.

Our contract 14-12-833 with Oak Ridge National Laboratory was extended another year at a cost of $147,000. Funds for this work were allocated out of the Athens, Georgia EPA Laboratory; consequently, Mr. William Donaldson of that laboratory was appointed project officer. Following consultations with both Oak Ridge and Athens, it was agreed that the work should proceed as originally planned by this laboratory. Mr. Donaldson and his staff are in agreement with us on the type of work needed and the order in which it should be done. We are assured maximum cooperation from Athens to carry on our planned program with Oak Ridge.

Limited work was done on this project during this period due to priorities of other work. We plan to resume it in the next quarter.

"Pesticides and PCB's" - 17070 TLB.

In support of the Task Force for Sludge Incineration, six sludge samples from surrounding areas were analyzed for polychlorinated biphenyls (PCB's). The amounts detected varied widely - from 3.3 μg/g in the Indianapolis filter cake to 105.0 μg/g in the Dayton digested sludge. This high level of PCB in the Dayton sludge is believed to originate at the National Cash Register paper recycling plant.

Two samples of supernatant from Clark County, Nevada sewage treatment sludge digester were analyzed for the presence of pesticides and PCB's. These samples were treated electrochemically by a process being developed at Pacific Engineering and Production Company of Nevada (PEPCON) for the removal of these organics from wastewater. Corresponding control samples were analyzed in the same manner. No significant removal of pesticides and PCB's was noted by this process. In addition to PCB's, Chlordane, Dieldrin, and DDD were detected in these samples in the 0.1 - 4.2 ppb range.

Because of the limited scope of the analysis the effect of this chlorination process on other compounds was not investigated.

Technical Services

We have been requested to assist the Division of Field Investigations in processing and analyzing carbon filter extracts of nine stations along the Ohio and Kanawha Rivers. This study is intended for an enforcement

conference - and perhaps an enforcement action later on - to be held in June 1972. Thus far, nine carbon filters have been processed and analyzed. Results indicate that the "dirty dozen" organic compounds that were persistently found in the Kanawha River and in the Ohio River below the mouth of the Kanawha River in the early sixties are no longer there. We are in the process of isolating a few of the more abundant fractions in some of the extracts hoping to identify these compounds.

Work Planned for Next Quarter

Continue with the analysis of samples for the Division of Field Investigations.

Initiate an investigation of the effect of chlorination on sewage components.

Resume work on the persistence of pesticides and PCB's in sewage.

C. I. Mashni

Presentations

On September 20, 1971, Mr. E. F. Barth presented "Design for Nitrogen Removal at Large Treatment Facilities." Vienna, Austria, First Workshop, International Association Water Pollution Research.

On September 29, 1971, Mr. Barth presented "Nitrogen Control Technology" and "Phosphorus Control Technology," at a Biological Treatment Course, National Training Center.

On October 6, 1971, Mr. C. W. Chambers presented a training lecture entitled "Disinfection of Treated Effluents" in Course 162 "Biological Treatment Technology," National Training Center.

On October 10, 1971, Mr. Barth presented "AWT for Nutrient Control," University of Washington, Seattle, Washington.

On October 18, 1971, Mr. R. C. Brenner presented "Oxygen Aeration for Secondary Treatment" at a training course entitled Advances in Treatment of Domestic Wastes, at the Athens, Georgia laboratory.

On October 19, 1971, Mr. Barth presented "Chemistry of Nitrogen and Phosphorus," "Biological Nitrification and Denitrification," and "Combined Biological-Chemical Treatment for Phosphorus Removal" at Course 1722 Advances in Treatment of Domestic Wastes, Athens, Georgia.

Publications

Barth, E. F., "Perspectives on Wastewater Treatment Processes - Physical, Chemical, and Biological." JWPCF 43, 2189 (1971).

Visitors

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QUARTERLY REPORT

MUNICIPAL TREATMENT RESEARCH PROGRAM

October - December 1971

PPB 1101

PROJECT: 1101 DAB - CUYAHOGA COUNTY BOARD OF COUNTY COMMISSIONERS
ROCKY RIVER PROJECT

OBJECTIVE: Demonstration of chemical clarification - carbon adsorption at 10 mgd scale as an alternate to secondary treatment.

PROGRESS: Bids were opened on November 4. The Project Officer has received a request for approval to award bids. The request is being considered and a reply will be sent to the County in January.

PROJECT: 1101 DGA - UNIVERSITY OF NORTH CAROLINA - "Improved Trickling Filter- Based Treatment System"

OBJECTIVE: The overall goal of this project is to develop practical design information which can be readily used by engineers in modifying trickling filter plants to enhance their performance and to develop practical techniques which can be applied by plant operators to attain maximum performance from existing and proposed units. Major experimental efforts during initial phases of the project will be directed towards improvement of BOD, suspended solids and nutrient removal.

PROGRESS: Two batteries of trickling filters were run in parallel to determine the effect of the suspended solids content of the recirculating stream. In one battery, the recirculation stream was returned to the primary settler; in the other battery, the recirculation stream was returned directly to the trickling filter. An earlier observation that the settling of the recirculating stream has little or no effect on plant performance was confirmed.

PROJECT: 1101 DJC - CITY OF MANVILLE, NJ - "New Process to Improve Quality of Trickling Filter Effluent"

OBJECTIVE: To demonstrate the feasibility of a moving bed filter for further clarification of trickling filter and other effluents.

PROGRESS: Mechanical problems in the 2 mgd moving bed filter have been corrected and the plant is scheduled to go onstream in January. Jar tests have indicated that a different polymer than originally programmed should be used.

PROJECT: 1101 DKI - CITY OF PAINESVILLE, LAKE COUNTY, "Porteous Process for Heat - Treatment of Sludge"

OBJECTIVE: Determine the effect of the Porteous Process on the filterability of sludges that are difficult to dewater.

PROGRESS: Installation of the Porteous Process equipment is underway. Start-up is scheduled for Fall, 1972.

PROJECT: 1101 DPW - CHICAGO, ILLINOIS - "Land Reclamation through the Use of Digested Sewage Sludge"

OBJECTIVE: The project objectives are to demonstrate the ultimate disposal of digested municipal sewage sludges through use of special agricultural management practices to raise crops on land that is receiving an accelerated rate of application of sewage sludges. It is hoped that an economical scheme for nonpollutional sludge disposal will result with the additional promise of a beneficial by-product, agricultural crop. Sludges from a 270 mgd plant will be processed.

PROGRESS: Winter wheat was planted on 30 acres that had received an application of sludge. The grantee has requested a no-cost extension until August to determine yields.

PROJECT: 1101 EBW - METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO "Performance Analysis of 15 mgd Microstrainer for Tertiary Treatment"

OBJECTIVE: Verify mathematical model development and obtain realistic cost and performance information on a large-scale microstrainer.

PROGRESS: Several problems have arisen in start-up of the microstrainer. The principal problem is that the grantee has been unable to process water at a flow rate greater than 8.5 mgd. Further research has been delayed until acceptance trials are completed.

PROJECT: 1101 EGL - CITY OF RICHARDSON, TEXAS - "A Demonstration on Enhancement of Effluent from a Trickling Filter Plant"

OBJECTIVE: The project objective is to upgrade the treatment of waste water in a medium-sized (1.5 mgd) trickling filter plant by chemical addition. Controlled doses of metallic salts (aluminum and iron) and an anionic polymer with the dual capability of improving suspended solids coagulation and precipitating soluble phosphorus will be utilized. The project will also demonstrate the relative costs of operating a standard rate trickling filter sewage treatment plant by the use of selected chemicals and combinations of chemicals and polymers.

PROGRESS: Supplemental funds for extension of the project to May, 1972 have been approved but not yet awarded. During the Fall, the molar Al/P ratio has been reduced to 1.4-1.5 to determine minimum ratio necessary. This plus the advent of lower temperatures resulted in a degredation of water quality. The phosphorus level increased to 1.0-1.2 mg/l, the COD to 50 and the suspended solids to 15 mg/l. The BOD was not affected. The addition of 0.3 mg/l anionic polymer ($10/10^6 gal) reduced the suspended solids carryover but the phosphorus remained above 1 mg/l. The contractor is now increasing the Al/P ratio, without polymer, to determine the level at which summer performance can be regained.

PROJECT: 1101 EGZ - CITY OF SAN ANTONIO, TEXAS - "Demonstration of Virus Removal from Municipal Sewage"

OBJECTIVE: To demonstrate suitability of lime coagulation for removal of virus from wastewater.

PROGRESS: The lowest of the original bids submitted was $50,000 over the engineers estimated cost. The lowest price resulting from the second request for bids was closer to the engineers estimate and a construction contract has been signed. Start-up is scheduled for late 1972.

PROJECT: 1101 ELP - JEFFERSON PARISH, DEPT. OF SANITATION - "Study Involving Aeration to Freshen Sewage and Retard Bacterial Activity in Long Sewers"

OBJECTIVE: Evaluate effectiveness of in-line aeration in reducing sulfide concentration and providing enroute sewage treatment. Methods to be used include, a) aspirated and diffused U-tubes, b) in-line venturi aerator.

PROGRESS: The modification of the system to reduce pressure drop in the U-tube has been completed. The Rocketdyne Corporation is assisting in evaluation of the two U-tube aerators but results of the tests have not yet been received.

PROJECT: 1101 ENX - LOS ANGELES COUNTY SANITATION DISTRICT NO. 2 - "Basic Research on Sulfide Occurrence and Control in Sewage Collection Systems"

OBJECTIVE: To study the conditions under which sulfides will occur in sewage, the effect of sulfides on the sewers and the effectiveness of various control measures.

PROGRESS: The first draft of the final report has been received and is being reviewed.

PROJECT: 1101 EVE - MILWAUKEE, WISCONSIN - "The Evaluation of a Top Feed Rotary Filter"

OBJECTIVE: Evaluate a top feed rotary vacuum filter for dewatering sludge.

PROGRESS: Investigation of the top-feed rotary filter is continuing. The fact that the cake is discharged in a downward direction, thus using instead of fighting gravity, seems to be of considerable benefit. The grantee is now investigating a revised top feed filter in which the filtering media leaves the surface of the drum after cake formation. It is anticipated that an application for an expanded study will be received. The grantee wants to study conventional and top feed filters in parallel at a larger scale to clarify the merits of the new system.

PROJECT: 1101 EYM - DISTRICT OF COLUMBIA DEPARTMENT OF SANITARY ENGINEERING "Joint FWPCA (WQO) District of Columbia Advanced Waste Treatment Research"

OBJECTIVE: The objective of this project is to perform special studies and investigations relating to waste treatment under conditions found in Washington, DC. Specifically it is planned to perform such studies and investigations on the following subjects: 1) determine the minimum conventional treatment needed to precede advanced waste treatment facilities by lime precipitation method, 2) investigate the feasibility of a physical-chemical advanced waste treatment process as an alternate for conventional waste treatment followed by tertiary-type advanced waste treatment, 3) investigate the feasibility of various dependent physical-chemical treatment processes that might be used at the DC Water Pollution Control Plant, 4) investigate the feasibility of selected solids handling and chemical recovery systems, 5) investigate the feasibility of modifications to the conventional treatment processes such as an alum addition to the aeration process, 6) develop the necessary design factors for the conventional and advanced waste treatment facilities investigated, 7) develop construction and operation cost estimates of all processes investigated, 8) perform such other pilot and laboratory studies as may be determined by both parties to be fruitful.

PROGRESS: Progress is being made on all systems. Final contract reports are being prepared. Emphasis is being placed on the operation of a three-sludge system incorporating alum addition. This process sequence, with filtration, removes 99% of the BOD, 95% of SS, 98% of PO_4 and 91% total nitrogen.

PROJECT: 1101 EZJ - METROPOLITAN SANITATION DISTRICT OF GREATER CHICAGO - "Hanover Tertiary Plant Studies"

OBJECTIVE: To evaluate various combinations of chemical treatment, upflow and downflow sand filtration, microstraining, chlorination, post oxidation, ion exchange and ammonia separation as tertiary treatment measures.

PROGRESS: No progress reports received

PROJECT: 1101 FDI - RESEARCH TRIANGLE INSTITUTE - "A Study of the Feasibility of Flow Smoothing Stations in Municipal Sewage Systems"

OBJECTIVE: Installation of smoothing basins for increasing sewer capacity has been compared to the addition of new sewers. The most sensitive parameters were found to be length of overloaded line, pipe slope, flow variations, basin construction methods, pipe design standards and existence of useable pump stations. It was concluded that flow smoothing should be an economically attractive means of increasing sewer capacity in regions having low slopes or existing pump stations or where earthen construction was feasible.

PROGRESS: The first draft of the final report is being reviewed.

PROJECT: 1101 FVO - LEVITT & SONS, Inc. - "An Advanced Physical-Chemical Wastewater Treatment Process for the Housing and Community Development Industries"

OBJECTIVE: To demonstrate the performance, economics, and applicability of a physical-chemical domestic wastewater treatment system designed to provide varying high quality discharges for isolated or developing communities having an average wastewater flow in the 25,000 to 500,000 gpd range.

PROGRESS: Satisfactory progress was made on this contract this quarter. The detailed design of the liquid flow sheet was completed and orders placed for all items of equipment. The design of the carbon contactor was changed to allow for upflow packed expanded bed operation if this mode of operation is required. The overall design concepts of the solids handling section were finalized as well as most of the design details. Orders for the equipment are now being placed.

PROGRESS: 1101 FVO (cont'd)

Construction of the foundation and frame were initiated and should be complete early in the next quarter. The schedule calls for plant start-up and shakedown by the end of the next quarter.

PROJECT: 1101 FWG - POMEROY, JOHNSTON, AND BAILEY - "Determine Technical and Economic Feasibility of In-Sewer Treatment of Sewage"

OBJECTIVE: By means of desk top, laboratory and field studies, determine technical and economic feasibility of in-sewer treatment for BOD reduction.

PROGRESS: The contractor reports that significant BOD reduction can be achieved in sewer lines by the introduction of air to the water. The least expensive system for in-sewer aeration appears to be a combination of shallow falls and aerated force mains.

PROJECT: 1101 GEV - NEW YORK CITY, NEW YORK - "Demonstration of the Pure Oxygen Aeration Process to Upgrade Existing Plants"

OBJECTIVE: To verify applicability of refitting an overloaded or high rate waste treatment facility with an oxygen aeration unit to improve plant performance.

PROGRESS: Plant start-up is now scheduled for early March. An increase in the average and peak strength of the incoming wastes over that predicted has necessitated increased expenditures for larger mixers. This plus increased costs in other areas total about $150,000. A request to cover this increase out of FY'73 funds (1101) is being prepared.

PROJECT: 1101 GXJ - ELECTRIC BOAT DIVISION OF GENERAL DYNAMICS - "Demonstration of Waste Flow Reduction from Households"

OBJECTIVE: Water savings will be evaluated for using reduced flow toilets and shower heads and for reusing laundry water for toilet flushing and lawn watering. After 4 months of the 28-month project, 8 test homes have been selected, additional water meters have been installed and recording of normal water usage patterns has been initiated. The program calls for 6 months of normal usage, followed by 12 months with water-saving devices, and then 6 more months of normal usage after the devices are removed.

PROGRESS: The first period of 6 months normal usage ended rather than commenced in October as reported last quarter. The installation of water-saving devices is underway and, where completed, measurements of water usage are being conducted. Preliminary results of the effects of such devices should be available next quarter.

PROJECT: 1101 HIR - CITY OF ELY MINNESOTA - "Lake Restoration by Phosphorus Control"

OBJECTIVE: This project calls for installation of facilities to provide an effluent with less than 0.5 mg/1 P, 26 mg/1 BOD and 30 mg/1 suspended solids. The high rate trickling filter effluent will be treated by two-stage lime clarification and dual media filtration. The final effluent will be chlorinated before discharge to Shagawa Lake.

PROGRESS: Construction contracts were awarded during the month and construction is underway. All appears to be on schedule for a start-up this Summer.

QUARTERLY REPORT

PHYSICAL AND CHEMICAL TREATMENT RESEARCH PROGRAM

October - December 1971

PPB 1105
PPB 1106
PPB 1702
PPB 1703

PPB 320105 NON-SEWERED MUNICIPAL WASTES

11050 DEU "Economical Residential Pressure Sewage System with No Effluent" The Grandview Lot Owners Association, Inc.

Work Done This Quarter

The final report for the first phase of this project has been received. Some of the salient points made in the report include:

1. Air release valves on the pressure sewer mainline are an absolute necessity.

2. Flushing of the mainlines on a regular basis has kept the lines free from sediment and assisted the release of entrapped air by the air release valves.

3. Hydraulic overloads to the system can be prevented by utilizing existing septic tanks for storage, with time-controlled pumping from these tanks during off-peak hours.

4. Six different types of household systems have been installed at the project. Their installed costs, including a 150-foot service line and curb cock, varied from $972 to $1292.

5. The pump-grinder-pressure-sewer system has had an excellent degree of public acceptance from the homeowners. This is due primarily to their previous experience with malfunctioning septic tanks and to the economic advantages of this system compared to the conventional gravity sewer estimate.

Plans for Next Quarter

Submission and review of the grant continuation application will take place.

11050 FOU "Pressure Sewer Demonstration", Borough of Phoenixville, Pa.

Work Done This Quarter

The first draft of the final report has been submitted, reviewed and returned to the grantee.

Plans for Next Quarter

The final report should be completed during the next quarter.

PPB 1702 DISSOLVED REFRACTORY ORGANIC REMOVAL

17020 TAW
17030 TBJ "Treatment of Raw Sewage by Chemical Clarification and Activated Carbon Adsorption"

1. General

Stable operation continued throughout the quarter with only minor operating problems. The system has been on stream since June 14, 1971. The data used for reporting purposes herein were collected from September 14, 1971, to November 23, 1971.

2. Clarification

Clarification operation continued essentially as in the previous quarter and is summarized in Table 1. The low sludge weight production for the high lime system resulted from data obtained during a period of time during which the sludge pump was not performing properly. There are also indications that the pH readings taken on the high lime system may have been inaccurate (low) by perhaps 0.5 pH units. Closer pH surveillance is now being maintained.

Continuous records of pH show that, while feeding lime at a constant rate, the pH of the lime system usually drops about 1 pH unit at around 10 a.m. to noon, then gradually increases again to a maximum the next morning. The high lime system exhibits similar characteristics although its diurnal variation is usually on the order of 0.2 - 0.4 pH units.

3. Filtration

The filters were operated at 2 gpm/sf. The rate of headloss buildup was greater for the iron system filter than for the lime system filters because of the nature of the iron floc and the occasional discharge of blanket solids over the clarifier effluent weirs.

Filtration efficiency is shown in Table 3. Removal efficiencies improved slightly over the last quarter probably due to improved clarifier control.

4. Adsorption

The carbon columns have been on stream a total of 2969 hours through November 23, 1971, having treated 62,350 gallons (5315 bed volumes) each. Carbon column removal efficiencies are shown in Table 4.

As would be expected the organic removal efficiencies of all carbon columns declined from last quarter, indicating partial exhaustion. Mass balances are being maintained around the carbon systems in order to compare capacities and will be reported in detail later. The loadings through 5315 bed volumes were in the range 20-30 gm COD/100 gm carbon. The anthracite column continued to exhibit no organic removal.

The carbon column influents were aerated for several days in order to determine if this would be a reasonable method of controlling sulfide production. The pressure on the lead columns increased from 12 psi to approximately 75 psi over the week-end and the aeration was discontinued. The DO in the carbon column feed seemed to stimulate slime formation and headloss buildup as had been noted at Lebanon and Blue Plains. The lead columns were extremely difficult to backwash. All columns were then put on a regular schedule of backwashing so that each column was backwashed an average of once every 5.6 days. Late in the quarter a program of routine sulfide sampling was begun.

5. Anticipated activity

The systems will continue to be operated as they have been until the exhaustion rate of the carbon can be determined with full confidence.

TABLE 1

CLARIFIER OPERATION

	Iron	Lime	High Lime
Flow Rate (GPM)	4	4	4
Overflow Rate (GPM/SF)(1)	0.57	0.57	0.57
Detention Time (Min)(1)	48	48	48
Chemical	$Fe_2(SO_4)_3$(2)	Lime + $Fe_2(SO_4)_3$	Lime
Average Dose (mg/l)	74 as Fe^{+++}	385(3) Lime + 15 as Fe^{+++}	790(3)
pH	6.0	10.0	11.3
Sludge Blowdown (% Flow)	6.0	4.3	4.9
Sludge Volume Production (% Flow)(4)	4.0	2.0	1.8
Sludge Weight Production (lb/MG)	1500	3700	3100

Notes

(1) Based on influent flow

(2) Ferrifloc ($\approx$ 20% Fe^{+++}) product of Cities Service Corp.

(3) As received (hydrated lime)

(4) Sludge volume based on volume of waste sludge after 30 min. settling

TABLE 2

CLARIFIER PERFORMANCE

Parameter	Raw	Iron		Lime		High Lime	
	mg/l	mg/l	% R	mg/l	% R	mg/l	% R
TOC	86	15.7	82	17.5	80	15.3	82
COD	278	40.0	86	69.5	75	45.2	84
TSS	134	23	83	15	89	15	89
P	9.3	0.8	91	1.1	88	0.6	94
Fe	1.1	8.7	-	0.7	-		
Turbidity[a]	55	14	75	15(13)	73	11(7.5)	80

Notes

a. JTU

b. () after neutralization

All values except turbidity are averages of composite samples.
Turbidity values are averages of daytime grab samples.

FILTER PERFORMANCE

Parameter	Iron			Lime			High Lime		
	mg/l	% R	Σ% R	mg/l	% R	Σ% R	mg/l	% R	Σ% R
TOC	9.9	37	88	12.1	31	86	12.3	20	86
COD	25.8	36	91	32.6	53	88	31.8	30	89
TSS	14	39	90	7	53	95	6	60	96
P	0.4	50	96	0.9	18	90	0.4	33	96
Turbidity[a]	2.6	81	95	4.0	69	93	2.1	72	96
Iron	7.1	18		0.5	29				
Color	9			14			13		

Notes

a. JTU

All values except turbidity are averages of composite samples.
Turbidity values are averages of daytime grab samples.

TABLE 4

CARBON COLUMN PERFORMANCE

Parameter	Iron			Lime			High Lime		
	mg/l	% R	Σ% R	mg/l	% R	Σ% R	mg/l	% R	Σ% R
TOC	4.4	56	95	6.2	49	93	4.6	62	95
COD	14.2	45	95	17.5	46	94	16.5	48	94
TSS	6	57	96	4	43	97	5	17	96
P	0.3	25	97	0.8	11	91	0.5	-	95
Color	3	67		5	64		3	77	
Fe	2.6	63		0.5	0				

Note

All values are averages of composite samples.

17020 EVQ "Photochemical Methods for Purifying Water"
University of California, Davis, California

The grantee received approval, directly from Washington, to continue this project until March 31, 1972, without additional Government funds. He will use this extension to evaluate all his prior data, carry out whatever additional experiments that remaining funds allow, and prepare a final report.

17020 DDC "The Effect of Porous Structure on Carbon Activation"
University of Colorado, Boulder, Colorado

The final report on this project is long overdue and the University Research Office has promised to expedite its completion.

PPB 1703 SUSPENDED AND COLLOIDAL SOLIDS REMOVAL

17030 DLX "Orthokinetic Flocculation of Heterodispersed Systems". University of California

Objectives: The specific objectives of this project are: (1) to determine the requirements for initial mixing in achieving high performance of precipitation-flocculation and disinfection processes, and (2) to establish a basis for optimizing the design of precipitation-flocculation-sedimentation systems for the chemical treatment of raw municipal wastewater.

Progress: Experimental work was completed in November. The final report ia being prepared.

17030 DKG "Backwash of Granular Filters Used in Wastewater Treatment". Iowa State University

Objective: To determine optimum design and methods for backwash of wastewater filters.

Progress: This project was funded to begin in October, 1971.

17030 TBJ "Removal of Toxic Metals in Physical-Chemical Pilot Plant". In-House

Objective: To determine removals of selected toxic metals by coagulation, filtration and carbon adsorption.

Progress: Mr. Toshiro Maruyama, visiting research associate from Japan, is running laboratory evaluations of metals removals with processes being used in the pilot plant. Data collection will begin in January on metal removals in the pilot plant.

17030 FQU "The Role of Polyelectrolytes in Filtration Processes". University of North Carolina

This project has been funded for its second year. A quarterly report is not available.

17030 DMA "Study of Upflow Filter for Tertiary Treatment". Jefferson Parish, Louisiana

Objectives: To evaluate the effectiveness of an upflow sand filter as a means of tertiary and secondary wastewater treatment. Final effluent from a high rate trickling filter plant, primary effluent and unsettled trickling filter effluent will be filtered in the upflow sand filter with and without chemical coagulants as filter aids.

Progress: The filter installation is essentially complete. Shakedown tests are in progress. Full-scale evaluation is expected to begin in early January.

17030 HMM "High-Rate Deep Bed Filtration of Activated Sludge Plant Effluent", Hydrotechnic Corporation

Work Done This Quarter

Pilot runs with the 3-inch columns have been performed with the following results:

1. No. 2 anthracite over No. 1220 sand appears to give the best combination of run length and quality.

2. 60 inches of anthracite over 24-inches of sand yields an effluent of a quality equal to 60 inches of anthracite over 36 inches of sand.

3. Filtration rates from 8 to 24 gpm/sf are being investigated along with various polymers and coagulants, alone or in combination.

Plans for Next Quarter

The 3-inch and 6-inch column runs will be completed and the data collated and analyzed.

17030 FWH "Experimental Investigation of a Continuous Filtration Process for Municipal Waste Waters". Research Triangle Institute

Work Done This Quarter

Runs with raw degritted wastewater produced COD and SS average removals of 44 and 62 percent, respectively. When primary effluent was fed to the filter, average removals were 23 and 65 percent, respectively, for these two parameters.

Plans for Next Quarter

The project runs will be completed, data analyzed and a draft final report submitted.

17030 EYA "An Experimental Study of Fluidized Bed Clarification as Applied to Sewage Treatment". Research Triangle Institute

Work Done This Quarter

The first draft of the final report has been submitted and is being reviewed.

Plans for Next Quarter

The review of the first draft final report will be completed, returned to the contractor and a second draft submitted to EPA.

Physical and Chemical Treatment Research Program

Presentations:

October 4, 1971	Irwin J. Kugelman National Training Center Course: Biological Treatment Technology - lectures on "Anaerobic Process Principles" and "Anaerobic Process Design"
October 5, 1971	James J. Westrick National Training Center Course: Biological Treatment Technology - lecture on "Physical-Chemical Alternatives"
October 18-20, 1971	Sidney A. Hannah Southeast Water Laboratory Training Course: Advances in Treatment of Domestic Wastes - lectures on "Chemical Removal of Phosphorus" and "Suspended and Colloidal Solids Removal"
October 27-29, 1971	Irwin J. Kugelman Design Seminar on Advanced Waste Treatment Technology Transfer - Atlanta, Georgia "General Information on Phosphorus Removal"
	Sidney A. Hannah Design Seminar on Advanced Waste Treatment Technology Transfer - Atlanta, Georgia "Available Methods for Nitrogen Control"
October 28, 1971	Jesse M. Cohen Clemson University Environmental Systems Engineering Seminar - Clemson, South Carolina "Recent Developments in Physical-Chemical Treatment Processes"
November 5, 1971	Jesse M. Cohen Ohio State University Environmental Seminar Series - Columbus, Ohio "Developments in Physical-Chemical Treatment: Removal of Nutrients and Toxic Substances"
December 1-3, 1971	Jesse M. Cohen Technology Transfer Design Seminar for Municipal Wastewater Treatment Facilities Panel: Design for New Technology and "Physical-Chemical Treatment Processes"

Physical and Chemical Treatment Research Program

October 4, 1971	Mr. Toshiro Maruyama, Guest Research Associate from Hakodate Technical College, Hakodate, Hokkaido, Japan, will be working with the Physical & Chemical Treatment Research Group through September 1972.

The Physical and Chemical Treatment Research Program had 58 visitors and the staff attended 8 meetings and conferences during this quarter.

QUARTERLY REPORT

TREATMENT OPTIMIZATION RESEARCH PROGRAM

October - December 1971

PPB 1709

TREATMENT OPTIMIZATION RESEARCH PROGRAM

1709 - Waste Treatment Optimization

Work Done This Quarter

1709 TJL "Standard Costs for Wastewater Collection and Treatment"

A thirty-one page report entitled "Costs of Wastewater Renovation" was prepared for presentation to an EPA conference held in Cincinnati on November 16-17, 1971. This report contains information on the cost of water supplies, water treatment for potable use, cost of advanced processes including desalting processes such as ion exchange and reverse osmosis, and the cost of conventional wastewater treatment. The cost of conventional water supply was taken primarily from the OSW sponsored work by Black and Veatch.

In order to determine the cost of conventional water supply for comparison with the cost of wastewater reuse, a digital computer program was developed which duplicates the computational procedure given in the OSW sponsored Black and Veatch Report. The principal shortcoming of this work appears to be the method used for determining the design capacity factor for impounding reservoirs, storage facilities, treatment facilities, etc. A low priority effort is underway to improve the method for determining design capacity factors in order that future studies of the feasibility of reuse will have a firmer foundation.

The major effort this quarter has been directed towards development of accurate cost estimating techniques for the advanced processes. Several major sources of generalized cost information have been obtained with the help of the cost estimating department of the U. S. Corps of Engineers in Mobile, Alabama. This information is in great detail and in order to become familar with the methods, we have been preparing cost estimates for columnar denitrification and break point chlorination for nitrogen removal. In order to properly cost columnar denitrification, it has been necessary to size and partially design all mechanical components of the process. For example, the pressure vessels must be sized, the wall thickness must be computed, and a layout made to cost the pressure vessel. The piping arrangement must be laid out in order that the piping, valves, and control equipment can be costed. Practical considerations, such as whether to use a flow equalization tank or flow matching equipment, must be resolved. It has been found that the

proper method of design is often not available. Close contact has been maintained with the particular engineers within and outside of EPA to find the best solution to each of these design considerations. This work on columnar denitrification is about 90% complete at this time.

The work on breakpoint chlorination is not as complete as columnar denitrification. Factors, such as the availability of the necessary equipment to feed these extreme amounts of chlorine and problems of storage, have been considered and help has been received from principal suppliers of chlorine.

As a result of our work on these two specific advanced processes, it has become apparent that the great amount of detailed computation required will severely tax the small TORP group unless ways can be found to computerize the computational procedure. It is hoped that the necessary digital computer programs can be developed when we have become sufficiently familar with the costing manuals now available. The U. S. Corps of Engineers have been very helpful in pointing out some of the more practical considerations, in supplying cost information, and in naming available cost estimation literature.

Our computing capability has been reduced with the removal of the IBM 1130 computer from the Columbia Parkway Building. The IBM 1130 stand alone computer has been replaced with a terminal which allows us to use the IBM 360 model 30 for a maximum of two runs per day. Substitution of the terminal for the IBM 1130 computer has also required conversion of the decks, which is very time consuming.

1709 TJJ "Cost-Effectiveness Studies"

A great deal of effort has been expended in computing the cost of phosphorus removal from wastewater by means of chemicals such as alum and iron, by means of lime clarification, and finally by means of filtration. The principal questions associated with this computation are the amount of excess sludge produced, whether excess capacity for sludge handling should be installed or whether it is now available, what sludge handling processes are now installed in existing plants, etc. A task force has been assembled in Cincinnati to work on this project, but more work is required before a final report can be completed. A great deal of preliminary information has been supplied to the Washington, D. C. headquarters staff.

A ten page report on the relative costs of automatic and manual measurement techniques for monitoring wastewater treatment plant effluent was prepared at the request of the Headquarters staff. This document, dated December, 1971, contains the current cost of installing instruments for measurement of volume flow, water temperature, pH, suspended solids concentration and total organic concentration in the effluent of wastewater treatment plants.

Plans for Next Quarter

The principal objective for the next quarter will be to complete cost estimates for columnar denitrification and break point chlorination for nitrogen removal. If time permits, work will be started on computerizing the cost estimation procedures for pressure vessels and concrete tankage. The cost of field erected pressure vessels has not been determined and some effort will be made to gather this information. Some design computations will be necessary in order to cost concrete structures. We plan to work with the CØST program in order to compare this program with cost relationships we know to be valid. This effort will also be hindered by the loss of our stand alone computing capability.

Presentations

October 12, 1971 R. G. Eilers
"Wastewater Treatment Plant Cost Estimation Program"
Presented at the CEPA Conference
Houston, Texas

Publications

"More Computer Programs for Chemical Engineers" December 27, 1971 issue of Chemical Engineering (15 EPA developed computer programs presented)

A.I.Ch.E. Document entitled "Automation of Wastewater Treatment Plants - What Parameters Shall We Measure"

Paper entitled "The Economics of Automation in Wastewater Treatment" by Robert Smith

Consultation and Advisory Services

A total of 55 letters requesting reports or computer decks were answered during the quarter.

Visitors

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QUARTERLY REPORT

ULTIMATE DISPOSAL RESEARCH PROGRAM

October - December 1971

328107

ULTIMATE DISPOSAL RESEARCH PROGRAM

The objectives of this Program have been assigned to the Ultimate Disposal Research Section with cooperation from other sections on projects related to these objectives. This work has formerly been reported under PPB 1707.

The assignments of the Ultimate Disposal Program are to find and improve ways for disposing of the sludges and brines removed from wastewaters by various treatment processes. Although most of the contaminants are "solids" in the analytical sense, the major fraction of the cost of disposal is directly related to the high water content of the waste stream. A typical sludge contains 20 tons of water per ton of dry solids and it costs $20 to $60 per ton of dry solids for disposal. A typical brine from a salt removal process may contain 400 tons of water per ton of salt and the cost of disposal is critically dependent on the location of the treatment plant.

Sludge from biological sources putrefies rapidly and contains high concentrations of pathogenic organisms. Activated sludge is a culture of bacteria which is wasted in a dilute suspension containing more than one hundred tons of water per ton of solids matter.

Need TAH. Thickening and Dewatering

Sludge may be thickened and dewatered for incineration rapidly enough to prevent putrefaction without any stabilization or disinfection. An RFP has been advertised for novel methods of dewatering. The request is based on the observation that conventional thickeners are not designed or operated to take advantage of the extent of water removal which can be achieved by this process. The cost of thickening is much less than the cost of any subsequent sludge treatment process when calculated on the basis of tons of water removed. Thicker sludges will substantially reduce the cost of most subsequent treatments. An RFP for comparative studies of dewatering equipment is in preparation.

All new processes for treating wastewater produce new waste streams with unknown properties. Laboratory work has been underway to measure the properties of sludges produced by some physical-chemical processes now being operated in the experimental wing under program 328103, TBJ. An iron hydroxide primary sludge was tested for filtrability in connection with a graduate student's thesis at the University of Cincinnati. The sludge was very difficult to filter in the absence of conditioning chemicals. Massive lime treatment increased the filtrability fourfold. A nonionic polymer, WT-2690, was also effective.

A sludge handling pilot plant is being installed at Lebanon, Ohio, under the supervision of Mr. S. Hathaway where larger quantities of sludge can be thickened and dewatered. These facilities will enable us to compare different sludges at a more realistic scale of operation. Initial work is concentrating on the operation of a one-foot square filter press which will be operated with additions of sludge ash as a conditioning agent.

The dewatering properties of primary sludges containing alum are being investigated at Blue Plains by Mr. Fred Bishop (8-202-962-0592).

ULTIMATE DISPOSAL RESEARCH PROGRAM (TAH continued)

Sludge handling data was reviewed, tabulated and analyzed for thirteen case histories where phosphorus was removed by chemical addition to either raw sewage, the activated sludge aeration tank, or the secondary effluent. For each chemical treatment system, the information on sludge solids concentration and production was obtained. The greatest increase in sludge mass occurred when Al^{+++} was added to secondary effluent, and the minimum increase in sludge mass occurred when lime was added at a level of from 800 to 1600 mg/l to raw sewage. In terms of additional sludge volume to be handled, the maximum amount would be expected with iron addition to the secondary effluent and the minimum with lime addition to raw sewage. In general, aluminum and iron sludges are more difficult to thicken and dewater than is lime sludge. To optimize any phosphorus removal system for sludge handling, it will be necessary to consider all the alternatives and their economics for reducing sludge mass and volume.

Air flotation is one effective method of thickening waste activated sludge. Attempts at Lake Tahoe to centrifuge the thickened sludge were too costly in terms of polymer requirements. A study at Irvine Ranch, California, under 328108 EDW also had trouble with centrifuging air floated sludge. A theoretical analysis shows that if a thickened sludge contains any residual air bubbles it is liable to "float" in the centrifuge resulting in poor solids capture. Although another explanation has been offered at Irvine Ranch, the possible effect of air bubbles has not been ruled out. (G. Stern is Project Officer, 513-871-1820.)

Esso Research is investigating the analagous process of oil flotation of sludge under a contract, HDA. This thickening process would only be useful in combination with a dewatering process that recovers the oil such as a Carver-Greenfield dryer or the wet-rendering process discussed under Need TAK. Mixed primary and secondary sludges, digested sludge, and activated sludges have been successfully concentrated to from 8.0 to 13.0%. Important process variables include the settling time after oil addition, the settling temperature, high shear agitation and the initial sludge solids concentration. Minor variables include the initial sludge temperature, the sludge pH, the oil type, the oil/sludge ratio, use of surfactants, and multiple extractions. Potential problem areas that require further study include a high TOC in the raffinate and the fluid flow of high solids content extracts.

Westinghouse is studying a novel filter involving capillary suction on a porous mat followed by compression. The work is being done under contract, HCZ. Polyurethane foam was found to more efficiently dewater aerobically digested sludge by capillary action than polypropylene felt. Sludges were dewatered from about 1.0% to 11% by capillary suction alone at loading rates of 2.5 lbs/hr/ft^2. The solids content of a waste activated sludge was increased from 2% to 9% by interacting it with nylon and polypropylene felts and a polyurethane foam, but at a loading rate of 1.0 lbs/hr/ft^2 . Some work has been done to evaluate the operation of the laboratory dewatering unit with waste activated sludge. Results showed that a sludge cake with 20% solids could be obtained from the compression roller with a solids loading of 0.5 lbs/hr/ft^2 and 40 mg/l of Dow's C-31 for conditioning. However, at a loading rate of 1.9 lbs. dry sludge solids/hr/ft^2, an 18% solids sludge cake was obtained. Some operational problems have been experienced.

ULTIMATE DISPOSAL RESEARCH PROGRAM (TAH continued)

Lehigh University has been studying the effect of ash additions to sludge under grant ECM. Ash from sludge incineration as well as pulverized fuel ash (PFA) have been used as filter aids. This study has shown major differences between ashes from varying sources and is correlating these differences with differences in the surface properties of the ash. Their results show that the effectiveness of solids to induce flocculation is enhanced by a material which has a high surface area and a high concentration of polar sites. A secondary effect of sludge ash is the introduction of free lime and other dissolved solids into the system.

For further information on any project discussed under TAH, Sludge Thickening and Dewatering, contact Dr. J. E. Smith, Jr., 513-871-1820.

Need TAJ. Sludge Stabilization

Before sludge can be stored or disposed of it must be treated to eliminate nuisance odors and reduce the danger of transmission of infectious disease. The conventional treatment for putrescible sludges is anaerobic digestion which dissolves some of the solids and converts part of them to methane. The cost of treatment of the dissolved substances in the supernatant was calculated to be about half the value of the methane produced based on the BOD and solids content using Chicago's schedule of industrial surcharges (R. B. Dean). The pollutional aspects of digester supernatant have been recognized before. Aerobic stabilization is an alternative to anaerobic digestion which does not cause as much pollution in the supernatant liquor. A grant at the University of Oklahoma is comparing anaerobic digestion with aerobic stabilization (Dr. R. L. Bunch).

Denver has been researching the aerobic stabilization of waste activated sludge for 18 months in a plant scale study. Their waste activated sludge typically has a suspended solids content of between 0.5 and 1.0%. The sludge is generally under aeration for an eight day period, and the process provides between 35 and 50% mass reduction. This mass reduction is quite significant since it means getting rid of from 25 to 39 tons of solids per day.

Pilot scale work has also recently been done which indicates that elevating the temperature of the process into the thermophilic range gives little improvement in stabilization rate, that a 4.5% solids sludge can be successfully stabilized using pure oxygen, and that a significant part of the mass reduction is accomplished in less than 10 days.

Shortly Denver will start thickening their waste activated sludge to greater than 2% solids before feeding to the aerobic stabilization process. The stabilized sludge will probably be vacuum filtered and disposed of by land spreading. Presently the stabilized sludge is air floated, mixed with raw and digested sludges from the same and other plants, vacuum filtered, and disposed of on land.

ULTIMATE DISPOSAL RESEARCH PROGRAM (TAJ continued)

Other stabilization processes being considered are: 1) high pH produced by lime which disinfects and increases filtrability, 2) Low pH produced by SO_2 along the lines of the old Miles Acid Process and the MacLachlan patents, 3) Chlorine as offered by Purifax, 4) Heat treatment as in the Porteous, Farrer, and Zimpro systems. A Porteous system is being installed at Lake County, Ohio, near Cleveland (Dr. J. B. Farrell is Project Officer, 513-871-1820), 5) Pasteurization following other treatments. In all stabilization processes the pollutional aspects of the liquid fraction require as much attention as the effect on the solid fraction. Dr. J. E. Smith, Jr., is coordinating work on this need (513-871-1820).

Need TAK. Recovery of Feed Values from Sludge

Activated sludge is a culture of single cell organisms which have been grown on the soluble substances which are present in sewage or are liberated from suspended solids by bacterial enzymes. The single cell organisms, like all other living cells, contain amino acids and carbohydrates. A contract at Foster D. Snell, Inc. (EKN) is examining the feed value of a hydrolyzate of activated sludge. In this process, for which a patent application is pending, sludge is pressure cooked in equipment similar to that used in the Porteous process. Sulfur dioxide is added as an aid to hydrolysis. The remaining solids are easy to filter and the resultant hydrolyzate is rich in essential amino acids and sugars. Evaporation of the hydrolyzate has produced a molasses which has been spray-dried to produce an "Organic Feed Concentrate." Feeding tests on chickens and rats are underway. For more information, contact Dr. R. B. Dean, 513-871-1820.

Need TAO. Treatment and Disposal of Sludge on the Land

Land disposal of wet sludge has been shown by Chicago to be less expensive than digestion, lagooning, Zimpro, incineration or drying for sale as fertilizer. A large number of small plants dispose of wet sludge on the land with little or no control other than prevention of runoff into surface waters. Land disposal of wet sludge can be carried out at low cost because it is not necessary to dewater or dry the sludge. As has already been noted, these processes are the most costly part of sludge treatment. Land disposal of wet sludge should not be confused with land treatment of sewage along the lines of the Muskegon demonstration. Sewage contains one hundred times as much water as sludge and the principal problem is that of hydraulic acceptance of the soil just as it is for septic tank fields. Nor should disposal of wet sludge be confused with the far more expensive alternative of filtering or drying sludge before applying it to the soil. The costs of drying outweigh the cost of transporting wet sludge for distances in excess of 100 miles according to studies reported at Chicago. Similar conclusions were made under a contract by the Bechtel Corporation.

Pretreatment of sludge before wet disposal has usually been by anaerobic digestion although some small plants employ aerobic stabilization. Any of the other stabilization methods can be employed but we have little information regarding the effects of most of the processes on pathogen survival. A study of the survival of fecal organisms on the soil after application of digested sludge has shown that Salmonella can survive for over one month on open fields. In areas where pathogenic bacteria would become a public health hazard some pretreatment will be desirable for disinfection.

ULTIMATE DISPOSAL RESEARCH PROGRAM (TAO continued)

Pasteurization is practiced in Europe as a low cost pretreatment before land disposal of wet digested sludge. Very large plants may use heat exchangers but it is usually more economical to use direct steam injection into the tank wagon raising the temperature above 60° at least 30 minutes before spreading. Chicago uses storage in lagoons for periods of several years. The coliform count in the lagoons after this storage is less than the count in the adjacent ship canal. Lime treatment above pH 11 is another effective way to disinfect wet sludge. The lime aids thickening which could reduce transportation costs. It is useful as an agricultural supplement and helps to detoxify most heavy metals in the sludge. Conventional treatment by anaerobic digestion or aerobic stabilization as normally carried out does not produce a significant degree of disinfection.

Professor Tom Hinesly at the University of Illinois has been studying the land disposal of wet sludge under a grant to Chicago MSD originating in the Solid Waste Program. Chicago has also studied the use of wet sludge to make corn grow on the rubble of a burned dump at Calumet (DPW) as a demonstration of the utility of sludge to reclaim low grade land. Two contracts at the Ohio State University have been studying sludge disposal. The microbial decomposition of sludge (EQY) is very sensitive to soil temperature but the soil type is of importance only in maintaining adequate soil moisture. A review of equipment useful for applying sludge is being worked on (EQX). An RFP to prepare a State of the Art Review of Land Disposal of Wet Sludge is being prepared.

A grant to the University of Connecticut (DKA) has supported studies of the disposal of septic tank sludges. Soil injection has been shown to be an effective method for disposal.

Work on land disposal of sludges is being managed by Mr. G. Kenneth Dotson (513-871-1820).

Unprogrammed Needs in Ultimate Disposal

Many coastal cities have disposed of the solids in their sewage by dumping them in the ocean. The adverse effects of this practice have been noted and such dumping may soon be forbidden. A task force was set up to evaluate alternative methods of sludge disposal. A second task force was set up to evaluate the air pollutional aspects of sludge incineration. A large part of the work of these task forces has been related to the chemical analyses of various sludges.

The experimental work conducted has been of substantial value. The following information has been obtained:

1) A broad spectrum of sludges has been analyzed for heavy metals, pesticides, and PCB's.
2) Incinerator input (sludge) and output streams (scrubber water, ash particulates) have been analyzed.

ULTIMATE DISPOSAL RESEARCH PROGRAM

3) We now have information on the fate of heavy metals upon incineration. We know that some metals (lead, zinc) have a higher concentration in the particulates than they had in the feed, and that all of the mercury appears to leave in the exhaust gases.

We intend to continue to collect information on metal content of sludges. We also plan to analyze sludges from a single plant for an extended time period to assess both the magnitude of the daily fluctuations which can be expected and the reproducibility of our measurements.

There are many questions remaining about incineration which need resolution. The fate of pesticides, PCB's, and other thermally stable volatile materials, when contained in sludge charged to a conventional incinerator, needs to be established. We should get better material balance information on the metals entering and leaving the incinerator. Better particulate removal devices should be proved out. Consideration should be given to an experimental program directed at these objectives possibly utilizing the incinerators at the Blue Plains pilot plant.

Dr. J. B. Farrell has represented Ultimate Disposal on the task forces. Mr. B. V. Salotto has supervised the collection of analytical data. The Manager of the Ultimate Disposal Research Program is Dr. R. B. Dean. All personnel in Cincinnati can be reached at 513-871-1820.

ULTIMATE DISPOSAL RESEARCH PROGRAM

Presentations:

10/4/71	Dr. J. B. Farrell served on a Panel Discussion on Sludge Disposal at the WPCF Meeting in San Francisco.
10/5/71	Dr. R. B. Dean gave a slide/tape presentation on "Ultimate Disposal to the Environment" to a training course at the Robert A. Taft Water Research Center.
10/11/71	Dr. J. E. Smith, Jr., gave a talk on Ultimate Disposal to the Environment to a training course on Water Quality Studies at the Robert A. Taft Water Research Center in Cincinnati.
10/14/71	Dr. R. B. Dean delivered a lecture on Colloids in Wastewater Treatment to a regular weekly Chemical Engineering Seminar at the State University of New York, Buffalo, New York.
10/29/71	Dr. J. E. Smith, Jr., gave a talk on Environmental Pollution Control at Courter Technical High School, Cincinnati, Ohio.
10/27/71	Mr. G. K. Dotson gave a talk on Land Spreading of Sludge to the Izaak Walton League, Hamilton, Ohio.
11/14/71	Dr. J. E. Smith, Jr., gave a talk at the Environmental Science Career Information Workshop for Explorer Boy Scouts, Netherland Hilton Hotel, Cincinnati, Ohio.
12/9/71	Dr. R. B. Dean gave a talk on Disposal of Water Works Sludges to a training course at the Robert A. Taft Water Research Center, Cincinnati, Ohio.

Publications:

"Disposal of Mercury Wastes from EPA Water Laboratories," by R. B. Dean, R. T. Williams, and R. H. Wise, Environmental Science and Technology 5(10), 1044-45 (October 1971).

Letter from Dr. R. B. Dean to the Editor of Environmental Science and Technology re article in July issue of ES&T by Dr. Hinrich Bohn on Methane from Waste (ES&T 5(11), 1069-70, November 1971).

Visitors:

There were 39 visitors to the Ultimate Disposal Research Program during this quarter.

QUARTERLY REPORT

VIROLOGY SECTION

October - December 1971

PPB 1603

VIROLOGY SECTION

Project : 16030 TIZ - Quantitative Detection of Small Quantities of Viruses in Large Volumes of Water

Objective: To develop methodology for quantitative detection of minimal concentrations of viruses in water.

The danger of transmitting virus diseases by the water route necessitates developing methods for detecting and monitoring small amounts of viruses in waste, renovated, and other waters. Since even a single virus particle may infect an individual upon ingestion, it is important to detect small amounts of viruses in large volumes of water.

Work done this quarter:

The possibility of trypsinizing primary rhesus cultures and using these secondary cultures for virus studies is being investigated. In addition, a new continuous cell line derived from African Green Monkey kidney is being tested for susceptibility to the various viruses used in general testing in this laboratory. To date this line appears as sensitive as primary rhesus cells to poliovirus 1 and echovirus 7 and better than the Vero line currently being used.

Coliphage f_2 and poliovirus 1 suspended in Cincinnati tap water was entirely retained by Seitz filters, whereas few viruses were adsorbed to Millipore filters. This has also been found to hold true for removing these viruses suspended in sewage effluents from the Lebanon and SEC sewage treatment facilities. On extraction of the Seitz filters with 3% beef extract about 75% of poliovirus 1 initially added to these sewage effluents could be recovered.

DNA and RNA have been suggested as a possible eluent for removal of adsorbed viruses from the membrane filter. In comparing DNA from calf thymus and RNA from Torula yeast with beef extract, marked differences were noted between f_2 and poliovirus 1. At very low concentrations, f_2 could be eluted from the filters equally well with DNA, RNA, or beef extract. On the other hand, elution of poliovirus 1 required a much higher eluent concentration with beef extract which was much more effective than RNA or DNA in its eluting capacity.

Work planned for next quarter:

1. A variety of bovine albumin extracts will be tested for their ability to elute viruses from silt.

2. Further testing will be undertaken with the Rao low pH method in order to assess the method's capability for recovering viruses from large volume water samples.

VIROLOGY SECTION

3. The f_2 virus will be studied as an analytical model.

4. Studies to improve methodology for recovering small quantities of viruses in large volumes of water will continue.

VIROLOGY SECTION

Project : 16030 TJD - Virological Services for EPA Field and Laboratory Operations

Objective: To assemble viral data from the Lake Superior study.

Work done this quarter:

On-site samples were collected from Lake Superior September 7th to 10th and processed in Cincinnati on the 11th of September. Additional 50- and 100-gallon samples were received on the 17th, 23rd, and 27th of September. The initial plan to do a comparative study of field-processed versus laboratory-processed samples was abandoned following initial evaluation due to the extremely good quality of the lake water, the large number of samples being taken and the low probability of finding viruses. Samples were collected at the water plant intakes of Silver Bay, Beaver Bay, Two Harbors, and Duluth; near the plant discharge of the Reserve Mining Company; and just below the sewage treatment plant outfall of Silver Bay and Two Harbors. All samples, including those taken near the sewage treatment plant outfalls, failed to yield viruses. However, tests conducted on the sewage plant discharges did show viruses entering the lake.

Poliovirus 1 added to lake water at 4 C showed a 30% decrease at 24 hours and an 80% reduction within 9 days. Within 24 hours, there was a 95% reduction in poliovirus 1 when the virus was added to iron ore tailings from the plant. This percentage increased to 97.5 after 9 days. Some of the apparent die-off was due to adsorption of the virus on the tailings. When the tailings were removed from the sample and the adsorbed virus eluted, there was a 23% recovery of virus in 24 hours. The recovery dropped to 14% after 9 days. Diluting the iron ore tailings with lake water resulted in an increase in the number of free viruses while decreasing the number recovered from the tailings.

Work planned for next quarter:

1. Compile viral data on river studies.

2. Process any field samples when requested.

VIROLOGY SECTION

Project : 1706 TJB - Comparative Disinfection of Viruses in Waste, Recreational, and Renovated Waters.

Objective: To determine the virucidal efficiency of iodine and other halogens on viruses in waste, recreational, and renovated waters.

Iodine and other halogens are very efficient virucides but, according to a report in the literature, phage RNA is not inactivated by iodine. One phase of this project is to determine whether phage RNA reacts differently to halogens than animal virus RNA and if not, whether a potential hazard thereby exists. Previous tests have shown that no viable particles of poliovirus 1 were recovered after 15 minutes of contact with iodine at pH 6. However, infectious RNA could be recovered from iodine-inactivated poliovirus 1 after 4 hours contact.

Work done this quarter:

When poliovirus 1 was added to a chlorine solution at pH 6 and the viral nucleic acid extracted from the inactivated virus, the extracted nucleic acid proved to be inactivated as well. Tests with coxsackievirus A9 gave comparable results. Apparently, unlike iodine, chlorine rapidly inactivates viral nucleic acid in the intact particle.

The chemical form of chlorine that occurs at high pH levels has been reported to be nonvirucidal. Because recent reports by one of our grantees have raised doubt about the validity of earlier studies, we tested the effectiveness of chlorine (about 0.4 mg/liter) in a pH 10 borate buffer against poliovirus 1. Of the added virus, 99% was destroyed in less than 1 minute. Thus, it appears that the disinfection activity of chlorine at high pH levels needs to be re-evaluated.

Studies were carried out on the effect of iodine on organisms present in activated sludge effluent and on poliovirus 1 added to the effluent. Of the indigenous bacteria and fecal coliforms present, 90% were destroyed by about 0.5 mg/liter of iodine in 3 minutes or less. Poliovirus 1 required considerably more time for the same percent of inactivation.

Work planned for next quarter:

1. Disinfection studies on bacteria indigenous to activated sludge effluents and on viruses added to these effluents.

2. The effect of pH and other physical chemical parameters on the virucidal activity of halogens will continue.

VIROLOGY SECTION

Grant Quarterly Report:

16030 EOV Gulf South Research Institute "Evaluation of Electrophoresis Filtration/Concentration as a Viral Detection and/or Removal System for Processed Waters"

A new proposal for this project has been received and is now under evaluation.

68-G150 San Diego Public Health Laboratory "Quantitative Virologic Studies of Sewage"

A final report on this project is awaited.

68-G259 Technion Research and Development Found. Ltd. "Coliphages as Virus Indicators in Water and Wastewater"

This grant is now up for renewal. A final report and a grant application have been received and reviewed. Action from Washington is still awaited.

VIROLOGY SECTION

Technology Transfer:

On October 1, 1971, Dr. Berg convened the first annual "Conference on Viruses in Waste, Renovated, and Other Waters," which was attended by most of this country's most knowledgeable scientists and engineers concerned with this area, and by some from overseas as well.

Dr. Berg presented a paper entitled "Removal of Bacteria and Viruses" at the Water Reuse Conference in Cincinnati on November 17.

Dr. Berg presented a seminar entitled "Current Status on Research on Viruses in Water and Wastewater" at Ohio State University on November 29.

Dr. Berg presented a seminar entitled "Recent Developments on the Problem of Viruses in Waste and Other Waters" at the University of Cincinnati on December 3.

On December 6 and 7 Dr. Berg addressed the staff of the Bureau of Laboratories, Florida State Health Department, Jacksonville, on "Occurrence and Hazards of Viruses in Water," and consulted with key members of the bureau on local problems in viral pollution and projected needs for renovation of water.

Meetings and Conferences:

There were 20 meetings or conferences involving Virology personnel.

Visitors:

There were 10 visitors to the Virology Section during this quarter.

Papers Cleared:

"A Comparative Study of the Inactivation of Viruses in Water by Chlorine." P. V. Scarpino, G. Berg, S. L. Chang, D. R. Dahling, and M. Lucas.

Publications:

"Recovery of Small Quantities of Viruses from Clean Waters on Cellulose Nitrate Membrane Filters." G.Berg, D. R. Dahling, and D. Berman. Applied Microbiology, 22 (4): 608, 1971.

"Integrated Approach to the Problem of Viruses in Water." G. Berg. Jour. San. Engineer. Div. ASCE, SA 6, 867, Dec. 1971.

QUARTERLY REPORT

WASTE IDENTIFICATION AND ANALYSIS ACTIVITIES

October - December 1971

PPB 1708
PPB 1709
PPB 1707
PPB 1700

Project: Waste Identification and Analysis Activities

Sub-Project: Bacteriological Studies of Domestic and Industrial Wastes

Objectives:

1. PPB 1708 - Wastewater Renovation and Reuse

   a. To develop techniques for the quantitative enumeration of pathogens (*Salmonella sp.*, *Pseudomonas aeruginosa*, *Shigella sp.*, *Bacillus anthracis*, *Leptospira sp.*, and others), as required by sewage treatment plants.

   b. Research studies of Fate of Microorganisms in Advanced Waste Treatment Processes.

2. PPB 1709 - General Waste Treatment Technology

   Identification of microbial fouling agents in various treatment processes such as reverse-osmosis, electrodialysis, etc.

3. PPB 1707 - Ultimate Disposal (as requested in connection with 1.b).

Work done this quarter

1. a (1) Research continues in attempts to isolate quantitatively *Shigella species* from wastewaters and treatment effluents. None of the various contemporary methods used for clinical isolations appear to be applicable to isolation from wastewaters, either due to phage present or toxicity of the waters. *Shigella* serotypes have been isolated from Cincinnati sewage, but mainly via direct methods.

   (2) A quantitative method for the isolation of *Serratia marcescens* has been obtained. This organism is mainly implicated in nosocomial (hospital) infections. Completion of study awaits receiving of materials ordered.

   (3) A total of 204 agglutination tests for *Shigella species*, and 679 tests for *Salmonella sp.* during the year.

   b (1) Expanded bed biological treatment (EBBT) sand was received from Lebanon studies. The anaerobic sludge was removed from the sand particles by ten successive washings of a portion of the sample with sterile buffer water. Ten grams of the sand was suspended in sterile pH 7.2 buffer water, shaken vigorously, and plated out in varying dilutions to obtain bacterial colonial growth of organisms attached to the sand particles. Isolated bacterial colonies (40) were picked for bacterial identification. The genera of bacteria isolated were:

Group	Bacterial Types	No. Strains	% of Strains	Relation To Oxygen
1.	Achromobacter sp.	5	12.5	Aerobic, facult.
2.	Aeromonas sp.	11	27.5	Aerobic, facult.
3.	Alcaligenes sp.	6	15.0	Aerobic, facult.
4.	Bacillus sp.	11	27.5	Aerobic & facult. anaerobe
5.	Escherichia sp.	1	2.5	Facultative anaerobes
6.	Mima polymorpha	2	5.0	Aerobic
7.	Paracolon sp.	4	10.0	Aerobic
	Total	40	100	

Common characteristics of the bacterial strains were 40/40 produced catalase, 38/40 reduced nitrates to nitrites, 29/40 utilize citrate as sole source of carbon and inorganic salts as sole source of nitrogen. An interpretation of the function of each of these genera may be in order, and only general characteristics may be given.

See Table on page 3.

2. Types (genera) of bacteria found in (Dupont) Reverse-Osmosis Product Water (Lebanon).

Genera	No. of Isolates	%	Pathogenicity
Bacillus sp.	11	44	
Bordatella pertussis	1	4	(Nemolytic whooping cough)
Flavobacterium sp.	2	8	
Micrococcus sp.	1	4	
Moraxella sp.	2	8	(Eye infections - conjunctivitis)
Paracolon sp.	1	4	(Fecal organisms)
Pseudomonas sp.	3	12	
Sarcina sp.	2	8	
Streptococcus fecalis	2	8	(Fecal organisms)

3. No requests this quarter.

GENERAL CHARACTERISTICS OF THE BACTERIAL GENERA ISOLATED FROM EBBT SAND PARTICLES

GENERA	Proteolytic	Reduce Nitrates to Nitrites	Amino acids as Carbon Source	Inorganic S as source of S	Attacks phenol & naphthalene	Ammon. salts & Amino acids as Nitrogen source	Glucose	H_2S produced	Opt. temp.	Oxidase prod.	Pathogenicity	Distribution
ACHROMOBACTER	+	+	+	+	+	+	(NC)	(0)	20-30C	(0)	No	Water & Soil
AEROMONAS	+	+	+	(+)	0	+	AG	(+)	20-37C	+	Fish	Water & infected fish
ALCALIGENES	±	±	±	NR	0	+	(NC)	(0)	20-37C	+	Some plants	Water & Soil
BACILLUS[1]	+*	(+)	+	NR	NR	(+) few	A(GV) **	NR	Var.	(0)	few species	Wide
ESCHERICHIA	(0)	+	+	±	0	(+)	(AG)	±	30-37C	0	Occas.	Feces, Soil & Water
MIMA POLYMORPHA	0	0	NR	NR	0	NR	NC	0	25-42C	(0)	Occas.	Human
PARACOLO-BACTRUM	±	+	+	±	0	(+)	(AG)	±	30-37C	0	Occas.	Feces, Soil & Water

NC no change ; ( ) means usually; + positive; 0 negative; A acid; G gas ; V variable; NR not reported ; *Strongly proteolytic spore formers; **Marked liberation of ammonia from proteinaceous substances may mask acid production; [1] Bacillus sp. may possibly contribute to primary liquefactions of macromolecules in anaerobic digestion.

Plans for next quarter

Continue studies for Shigella quantitation.

Studies of out-house composts for pathogens.

Studies of potable waters for indicators and pathogens (wells as available).

Prepare presentation for Society of American Microbiologist Symposium on viruses and indicator bacteria in April 1972.

Studies as requested for PPB 1709 and 1707.

Consultation and Advisory Services

Consultation with Mr. E. J. Struzeski, Denver Enforcement Chief, concerning possible pathogen analysis of sugar mill wastes in Denver Region.

Consultation with three staff members of Rodale Press concerning growing numbers of gardeners and farmers wishing to compost "out-house" wastes. Samples expected to test safety.

B. A. Kenner

B. A. Kenner

P. C. Haley

H. P. Clark

Project: Waste Identification and Analysis Activities

Sub-Project: Identification and Analysis of Inorganic Components of Domestic and Industrial Wastes

Objectives: To provide analytical support to the other Advanced Waste Treatment Research Activities and their contractors.

Work done this quarter

The laboratory provided analytical services for the Advanced Waste Treatment Research Laboratory, and others, as listed below:

Biological Treatment Research Activities

Virology Section

Physical and Chemical Treatment Research Activities

Ultimate Disposal Research Activities

Newtown Fish Toxicology Facility

EPA Task Force on Sludge Disposal Albuquerque, New Mexico Project.

This service consisted of performing in excess of 4,300 analyses per month encompassing 35 different parameters.

Southeast Water Research Laboratory

Assistance was given to Mr. Frank Allen, of the Southeast Water Research Laboratory, with his preparation of wastewater samples. These samples were to be taken back to Athens and used in their organic identification studies.

Pacific Engineering Samples

A series of samples was received from the Pacific Engineering Company and analyzed for several parameters. The samples were sludge supernatants that had been treated with the "PEPCON" chlorination process.

RTW

Robert T. Williams

Waste Identification & Analysis Activities

Research Grant Application Review

Review of Research Grant Application No. 71-G689 (1711) Newark College of Engineering, Newark, New Jersey.

Conferences Meetings

Attendance at conferences and meetings by WI&AA staff members - 8.

Visitors - Consultations and Seminars

Conferences, consultations and seminars attended by WI&AA staff members - 11.

Training

Benjamin Lykins - University of Cincinnati (Evening College) - Environ. Microbiology I. Basic Principles of Biology, Microbiology and Biochemistry, With Emphasis on the Activities of Microorganisms and Their Effect on Man and His Environment - September 27 through Dec. 11, 1971.

Personnel

Assignment: Robert A. Burgess was assigned to WI&AA under the supervision of Harold P. Clark as a laboratory aid. N Y C assignment was effective November 18, 1971.

Retirement: Pauline C. Haley, effective January 7, 1972. Miss Haley, Biological Laboratory Technician (Microbiology) is retiring after some 33 years of Government service.

Presentation

"Automated Analysis for Environmental Pollution Control" by L. J. Kamphake and R. T. Williams was presented at the Technicon's International Symposium, Paris, France, November 8 - 10, 1971.

Publications

In-House publication "Simultaneous Quantitation of Salmonella Species and Pseudomonas Aeruginosa. I. Polluted Water. (B. A. Kenner); II. Persistence of Pathogens in Sludge-Treated Soils (B. A. Kenner, G. K. Dotson, J. E. Smith); III. Analysis of Waste Treatment Sludges for Salmonella Species as a Surveillance Tool" (B. A. Kenner).

Well received by E P A laboratories at Duluth, Corvallis, Dauphin Island, Alabama, and Charlottesville, Virginia. Much inquiry from USDA laboratories and F.D.A.

"Disposal of Mercury Wastes from Water Laboratories" by R. B. Dean, R. T. Williams, and R. H. Wise. Environmental Science & Technology, Vol. 5, 10 - 45, October 1971.

QUARTERLY REPORT

INSTRUMENTATION AND AUTOMATION

October-December 1971

PPB 1711

QUARTERLY REPORT

Instrumentation and Automation

PPB 1711

The scope of work for the State of the Art Report on Instrumentation and Automation has been prepared and approved for advertisement. The contract will include a literature survey, a users' experience survey, design of alternative control strategies for each unit process and cost analysis for the controls. The results of in-house and grant efforts in the areas of sensor evaluation, cost-benefit analysis of alternative control schemes and process performance changes under controlled conditions will be incorporated in the report.

A cost-benefit analysis of four control schemes for removing phosphorus from an aerator has been completed. A potential savings in chemical costs alone of $40,000 per year for one 10 MGD plant would be attainable with a feed-forward-mass-proportional control scheme compared to flow proportional control alone. This did not include the savings in sludge handling costs that can be expected.

The Palo Alto Proposal is undergoing pricing analysis at Headquarters but should be awarded very soon.

Work plans for FY'72 were finalized and discussed with AQCL. Resources for AQCL during FY'72 are committed. However, during FY'73 AQCL would like to carry out environmental testing and evaluate process control equipment of program interest for conformance with specifications.

An in-house effort is being initiated to modify the autoanalyzer for measurement of total phosphorus on unfiltered raw sewage samples. This does not include automated sampling and sample preparation. This effort will be contracted for the end of this fiscal year or early next fiscal year depending on fund availability.

Purchase requisitions have been prepared to purchase the new Orion and Cambridge free ammonia probes for in-house testing.

Continued contacts have been made with analytical equipment developers to determine new developments.

Automated Environmental Systems plans to market a <u>continuous</u> on-line process TOC Analyzer late this spring. This analyzer should be superior in as much as it eliminates the sample injection problems associated with the Ionics TOC Analyzer.

Delta Scientific plans to market a total phosphorus analyzer in the late spring. The analyzer will use a novel digestion system and should sell for $6-7000. Their current ortho-phosphate analyzer sells for $3,000.

Work Planned Next Quarter

Define ranges of interest of process variables for control requirements.

Prepare FY '73 work plans.

Award State of the Art Report

Develop information on individual process performance under controlled operating conditions.

Initiate evaluation of ammonia probes if received.

John J. Convery

OFFICE OF THE DIRECTOR OF RESEARCH
ADVANCED WASTE TREATMENT RESEARCH LABORATORY

October - December 1971

VISITORS:

Total 109

FOREIGN VISITORS:

10/20/71 Nagaichi Suga, President
Toyo Rika Company, Ltd.
Tokyo, Japan

10/22/71 Group of 6 Frenchmen - Paris, France. Group Leader: Mr. Pierre Chanteloube (contact made through Dorr-Oliver, Inc., Stamford, Connecticut)

11/8/71 Swedish Environmental Group - EPA-P&G Participation
Winton Hill Technical Center
Center Hill Road
Cincinnati, Ohio
(visit coordinated by NERC-Cincinnati)

Valfrid Paulsson, Director General of Sweden's National Environmental Protection Board

Alex Iveroth, President of the Federation of Swedish Industries

Allan Johansson, Counselor of the Department of Agriculture with responsibility of all environmental control activities

Jan Maartenson, Secretary General of the Swedish National Committee for the UN Conference on Human Environment to be held in Stockholm in 1972

Lars Sjunneson, President, Association of Swedish Pulp Industries

Leif Bruneau, Deputy Managing Director, Swedish Air and Water Pollution Research Institute

Bo Helmerson, Director, Environmental Affairs, Swedish Federation of Industries

Eric Sundblad, President and Chief Executive Officer, Stora Kopparbergs, Bergslags, AB (mining, steel, pulp and paper)

Sven Manssen, Director, Felix Food Company

Torster Andersson, Director, Swedish Esso Corporation

In addition to the above, there were 2-3 heads from the National Environmental Protection Baord. The remainder of the group (5 or 6 others) consisted of top-level management of Swedish industries and representatives of Swedish labor organizations.

FOREIGN VISITORS: (continued)

11/11/71	Bernard Watelet, Engineer In Charge-Pollution Control Societe Nationale des Petroles d'Aquitaine (S.N.P.A.) France
11/18-23/71	Luisito de Leon Jugo - UN Fellow Phillipines
11/29-12/1/71	Hanato Tsuruga Laboratory of Tokyo Tokyo, Japan

TOUR GROUPS:

10/7/71	Tour Group of 40 Delegates to the National Institute of Governmental Purchasing Agents Conference held in Cincinnati, Ohio. This group expressed a great interest in the environment
10/18/71	Tour of AWTRL given to Charles W. Snodgrass, Assistant Clerk, House Appropriations Committee for Agriculture & EPA, Washington, D.C. (coordinated through Office of Public Affairs, NERC-Cincinnati
11/23/71	Tour Group - Professor Peterson and 20 students - Miami University, Oxford, Ohio. Students are all majoring in the Environment Science Degree Course

CONFERENCES:

F. M. Middleton and staff met with the following:

10/29/71	J. Earl Bailey, Associate Professor of Aerospace Engineering, College of Engineering, The University of Alabama. Professor Bailey made a presentation on the results of his studies on mathematical modeling of the activated sludge process for process control

MEETINGS: (general)

10/8/71	F. Middleton, J. Convery, F. Rohrman and R. Bridges attended a Contracts Management Division Seminar presented by Ed. T. Rhodes, Director, Contracts Management Division, OR&M, EPA, Washington, D.C. in Cincinnati, Ohio
10/19/71	J. Convery attended meeting of AWT staff and SWRD representatives at the Taft Center in Cincinnati for discussions on Sewer Disposal of Ground Solid Waste
11/18/71	F. Middleton, J. Convery, F. Rohrman, R. Bridges and W. Tolliver attended a series of meetings held with W. Rosenkranz, D. Wright and L. Gray from EPA, D.C. at the Taft Center in Cincinnati

MEETINGS: (general - continued)

11/22-23/71	F. Middleton and J. Convery attended meeting held with F. Bishop and T. O'Farrell from the Blue Plains Pilot Plant, Washington, D.C. at Taft Center, Cincinnati
12/23/71	F. Middleton speaker to participants of the A.I.D. Mid-winter Community Seminar at the Taft Center, Cincinnati. (25 graduate students from various European and African nations for survey of Cincinnati's Health and Environmental Facilities in cooperation with International Visitors Bureau)

MEETINGS: (International)

10/23-11/2/71	F. Middleton headed a delegation of five Americans to attend the US-Japan Conference on Sewage Treatment Technology in Tokyo, Japan. Also visited Kyoto and Osaka, Japan during visit. Mr. Middleton presented paper "Municipal Pollution Control Technology in the U.S. of America" - Translated into Japanese.
11/27-12/18/71	F. Middleton to London, England and Geneva, Switzerland. (London - 1 day to meet with British and French Government Officials on CCMS Advanced Waste Treatment Project; Geneva - to participate in a meeting of experts in Wastewater Reuse, followed by a written report at the request of the World Health Organization. Title: Consultation on Methods of Wastewater Treatment and Health Safeguards in Relation to the Reuse of Effluents)

PUBLICATIONS:

August 1971	Rohrman, F. A., ANALYZING THE EFFECT OF FLY ASH ON WATER POLLUTION, Power, copyright McGraw-Hill, Inc., 1971
November 1971	Middleton, F. M. and Stenburg, R. L., RESEARCH AND DEVELOPMENT NEEDS FOR ADVANCED WASTE TREATMENT PROCESSES TO SERVE FUTURE NEEDS. Proceedings of Conference on Clean Water For Our Future Environment, Sanitary Engineering Division, American Society of Civil Engineers (co-sponsored by Los Angeles Section, ASCE)

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